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Studies on chironomid midges of the Tama River

Part 3. Species of the subfamily Orthocladiinae recorded at
the summer survey and their distribution in relation
to the pollution with sewage waters

Manabu SASA

Part 4. Chironomidae recorded at a winter survey

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NIES

THE NATIONAL INSTITUTE FOR ENVIRONMENTAL STUDIES

環境庁 国立公害研究所

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Studies on chironomid midges of the Tama River*

Part 3.

Species of the subfamily Orthoclaadiinae recorded at the summer survey and their distribution in relation to the pollution with sewage waters¹⁾

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1) **Studies on Chironomidae of Japan. Part 9, from NIES.**

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- Part 2 Sasa, M. (1978): Taxonomical and biological notes on *Tokunagayusurika akamusi* (Tokunaga), with description of immature stages (Diptera, Chironomidae). Jpn. J. Sanit. Zool. (Eisei Dobutsu), **29**, 93–101.
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INTRODUCTION

Little has been known on the species of chironomid midges breeding in the rivers and streams of Japan and the Orient, and their distribution in relation to the degree of pollution with sewage waters. A survey of chironomids breeding in a tributary of the Tama River was made on 17 August by Sasa, Yasuno, Ito and Kikuchi (1980, Part 1) by collecting bottom samples at 6 stations of Minamiasakawa, and descriptions of adults and some immature stages of 20 species of the subfamily Chironominae were made by Sasa (1980, Part 2). This paper deals with description of additional species (mainly members of subfamily Orthocladiinae) recovered from the same samples as reported in the previous papers (Part 1 and 2). Methods for collection, rearing and examination of specimens are the same as those reported in the previous papers by Sasa (1979, 1980). The numbers of adult chironomids recovered and identified from samples collected at Stations from No. 1 to No. 6 are given in Table 1.

As shown in this table, altogether 19 species of the subfamily Orthocladiinae and 3 species of Tanypodinae have so far been identified by the author as being recovered from bottom samples collected at the six stations in a single survey carried out on 17 August 1979. In the present paper, accounts are made on 13 species of the former subfamily, and descriptions of species of the genera *Corynoneura* and *Thienemaniella* as well as those of the subfamily Tanypodinae will be made in another paper now in preparation. Of the 13 species discussed in this paper, six had to be described as new, two were identified as being the same as those described by Tokunaga (1936, 1939) from Kyoto area, and 5 were treated tentatively as being the same as those found and described from Europe or elsewhere.

It has again been shown in this survey that each species of chironomids has its specific habitats along the river highly correlated with the degree of pollution with sewage waters. Species such as (1), (2), (8), (9), (11), (13) and (14) obviously prefer unpolluted mountain streams as their larval habitats, while others like (4), (5) and 12 breed selectively in the more polluted parts of the river. Very interesting is the fact that some species like (3), (6), (7), (15), (16), (18) and (19) are found in the intermediate zones between the extremes, which again suggests that chironomids will possibly be used in near future as excellent and sensitive indicators of the degree of water pollution with sewage waters.

Table 1. Numbers of males (M: left) and females (F: right) recovered from samples collected at six stations of the Minamiasakawa River, 17 August 1979

Species	Station Number														Total	
	1		2		3		4		5		6					
	M	F	M	F	M	F	M	F	M	F	M	F	M	F		
1. <i>Brillia japonica</i>	1													1		
2. <i>Eukiefferiella tamaflavus</i>		1	3	2		2								3	5	
3. <i>Synorthocladius tamaparvulus</i>				1	8	7								8	8	
4. <i>Cricotopus bicinctus</i>									1		31	23	32	23		
5. <i>Cricotopus sylvestris</i>											25	19	25	19		
6. <i>Cricotopus tricinctus</i>									1					1		
7. <i>Cricotopus triannulatus</i>									2					2		
8. <i>Cricotopus tamannulatus</i>	1	1												1	1	
9. <i>Cricotopus metatibialis</i>	5	2												5	2	
10. <i>Cricotopus tamasimplex</i>					1									1		
11. <i>Paratrachocladius tamaater</i>	5	2												5	2	
12. <i>Nanocladius tamabicolor</i>							3	6	18	20	35	31	56	57		
13. <i>Parametriocnemus stylatus</i>	2	3	2	1	4	1								8	5	
14. <i>Corynoneura</i> sp. A	4	3												4	3	
15. <i>Corynoneura</i> sp. B			21	10	5	7								26	17	
16. <i>Corynoneura</i> sp. C									3	1				3	1	
17. <i>Corynoneura</i> sp. D	1													1		
18. <i>Thienemanniella</i> sp. F					3	1								3	1	
19. <i>Thienemanniella</i> sp. G									2	3				2	3	
20. <i>Pentaneura</i> sp. nr. <i>maculipennis</i>			2	1	3	6								5	7	
21. <i>Pentaneura</i> sp. nr. <i>melanopus</i>			2	1										2	1	
22. <i>Pentaneura kyotoensis</i>				1		1			1					1	2	

DESCRIPTION OF SPECIES

(1) *Brillia japonica* (Tokunaga, 1939)

Materials studied. A male, emerged on 22 August from a sample collected on 17 August 1979 at Station No. 1 of Minamiasakawa, mounted in gum-chloral together with associated pupal skin (No. A53:81). In addition, the following specimens were recovered from materials collected on 12 December 1979: 3 males and 2 females (all associated with pupal skin, one also with a larval skin) emerged from samples collected at Station No. 2 and No. 3; 2 pupal skin, both associated with larval skin, collected on 30 December and 2 January, from samples of Station No. 2.

Males collected by the author at the type locality of Kibune, Kyoto, on 3 November 1976, were also available for this study.

Male. Body length 3.24 mm in the summer specimen, 4.38–4.74 mm in the winter specimens. Wing length 1.80 mm in the summer specimen, 2.16–2.27 mm in the winter specimens. Ground color of scutum yellowish brown, scutal stripes dark brown and well defined, scutellum brown, postnotum dark brown, halteres white, leg segments almost uniformly brown, wings brownish in reflecting light; abdominal tergites mainly dark brown.

Head in Fig. 1-A. Antennal flagellum 13 segmented. AR 0.54–0.76 (0.65 in average of 4), with some 10 long curved sensory setae near the tip (Fig. 1-B). Eyes bare and with a long and narrow dorsomedial projection, only narrowly separated from each other, ER values very small, 0.16–0.22 (0.20 in average of 4). Supraorbital setae numerous, 20–30 on each side in multiple rows (25 in average of 4 pairs). Clepeal setae 22–32. Palp 4 segmented (84, 150, 150, 176 microns).

Thorax in Fig. 1-C. Antepronotum well developed, separated in the middle, with a row of 10–15 dorsal setae along the entire length on each side and a group of 14–17 lateral setae near the ventral end (the presence of setae on the dorsal part of antepronotum is characteristic of this genus). Scutum without dorsomedian setae, with numerous (58–83) dorsolateral setae in double or triple rows on both sides (all arising from a large pale pit), and 14–26 supra-alar setae on both sides. Scutellum with 40–61 setae in irregular rows. Wing venation in Fig. 3-A and Table 2-1. Wing membrane brown in reflecting light, thickly covered with numerous macrotrichiae. Squama fringed with 22–27 setae. Anal lobe rather flat. R 1 and R 4+5 closely set, R 2+3 absent. Costa slightly produced beyond end of R 4+5. fCu slightly beyond r-m. Cu 2 only slightly bent.

Relative length of leg segments in Table 3-1. fLR 0.83, 0.80 (relatively high), mLR 0.50, 0.49 (relatively low), hLR 0.54, 0.54 (only two specimens were fitted for measurements of leg ratios). Front tibia with one long spur (51 microns; Fig. 1-F); middle tibia with two long spurs, both sinuate and barbed (60 and 56 microns), and a terminal comb composed of 8 simple, separated spurs 72–44 microns long (Figs. 1-D, E). Tarsi I with relatively long beards, fBR 3.1, mBR 4.2, hBR 3.9. All legs with well developed claws and empodium, and with a pair of small pulvilli (Figs. 1-H, I).

Abdominal tergites with numerous long setae distributed almost evenly on the entire surface. Hypopygium in Figs. 2-A, B, C. Ninth tergite with a reticular area in the middle, and with about 14 long hairs on both sides. Anal point absent.

Gonocoxite nearly cylindrical, and with a long, finger-like inner lobe bearing some

(VI-d). Tergite VII with a large spinulose (not spinose) area covering almost the entire surface, and a row of large, stout and pigmented spines along the caudal margin (-c). In addition, tergites III to VII with a pair of lateral longitudinal spinulose areas. Tergite VIII with a large central spinulose area, and a transverse row of large, stout and pigmented spines along the caudal margin (Fig. 4-E). Sternites II to VIII with a large central spinulose area (-v); in addition, sternites IV, V and VI with a pair of whirl-like spinose areas in the caudolateral corners (IV-w, V-w, VI-w); sternites VII and VIII with a row of large, stout and pigmented spines along the caudal margin, similar to that seen along the caudal margin of the respective tergites. Segments II to VII with 4 pairs, segment VIII with 5 pairs of lateral hairs, among which those on segments VII and VIII are long and filamentous (L-type), while those on the more proximal segments are short and simple (S-type). Terminal segment (Fig. 4-E) with a spinulose area both on tergite and sternite, a pair of triangular anal fins each bearing 3 stout and hook-like setae 114–128 microns long (Fig. 5-I), and 18–30 long and filamentous fringe hairs.

Larva (description based on 4 larval exuviae associated with pupal exuviae and adult males). Head capsule about 0.80 mm wide (when dissected and extended) and 0.55 mm long (from basal margin to base of antenna). Antenna 5 segmented (63, 8, 24, 12, 7 microns; Fig. 5-E); segment I 1.24 times as long as combined length of segments II–V, with a ring organ near the base; segment II very short, nearly as long as wide; Lauterborn's organ vestigial, situated at the tip of segment III; antennal blade striated and very long, (72 microns), 1.41 times as long as combined length of antennal segments II–V. Mandible 174 microns long and 67 microns wide, with 5 cutting teeth, a long accessory blade (30 microns long), and mandibular brush (Fig. 5-E). Labial plate with 12 teeth, the middle teeth paired and wider than the other pairs (Fig. 5-A, drawn by combining two separated head capsule of larval exuviae). Maxilla in Fig. 5-C. Dorsal aspect of labrum in Fig. 5-B. Ventral aspect of labrum, premandible and epipharynx in Fig. 5-C. Anterior pseudopods with comb-like claws of varying sizes (Fig. 5-F). Preanal hair tufts composed of 8 strong and long hairs and two shorter hairs arising from a roughly cylindrical base nearly twice as long as wide (Fig. 5-G). Posterior pseudopods with claws and basal spines as in Fig. 5-H.

Discussion. *Brillia japonica* Tokunaga was described by Tokunaga (1939, p. 306) as a new species with male and female collected at Hachijo, Kibune, Kitashirakawa and Yamashina of Kyoto Prefecture. Morphology of pupa and larva is newly described in this paper.

Male of this species is morphologically a typical example of the genus *Brillia* Kieffer as defined by Brundin (1956, p. 68), since eyes are bare and with a long dorsolateral projection (Figs. 1-A, 3-B), antepronotum is well developed but widely separated in the middle and with numerous dorsal hairs (Fig. 2-F), scutum without dorsomedian setae and with numerous dorsolateral and prealar setae in multiple rows (Figs. 1-c, 3-D), wing with numerous macrotrichiae, anal corner rather flat, R 2+3 absent, terminal spurs of tibiae are all well developed, strongly sinuate and with basal barbs, pulvilli are present but very small, abdominal tergites covered almost evenly with numerous hairs, hypopygium without anal point, gonocoxite with a long finger-like inner lobe, and gonostylus is forked into a longer and a shorter arms (Fig. 2-A).

Female of this species can be separated from those of other co-existing species by body coloration, absence of dorsomedian setae and presence of numerous dorso-

15 short and orally directed setae on the distal half (Fig. 2-D). Gonostylus bifurcate, the accessory arm about 2/3 as long as the main arm (Fig. 2-E).

Female (description based on a single specimen emerged from the winter collection, which was first examined dry on a pin, and later boiled in alkali, dissected and mounted in gum-chloral). Body length 2.44 mm (measured as a dry specimen). Wing length 2.40 mm. Body coloration as in male, ground color of scutum yellowish brown, scutal stripes dark brown and well defined, scutellum brown, postnotum dark brown, halteres yellow, wing membrane slightly brown in reflecting light, legs almost uniformly brown, abdominal tergites dark brown.

Head in Fig. 3-B. Eyes bare, with a conspicuous dorsomedial projection, ER 0.27. Antenna composed of a disc-like pedicel bearing 4 long setae, and 5 additional flagellar segments (101, 60, 72, 72, 72 microns), the last segment with a long subapical seta (92 microns; Fig. 3-C). Palp 4 segmented (82, 200, 186, 260 microns). Supraorbital setae 46 on each side. Clypeal setae 36.

Anteprenotum well developed, deeply divided in the middle, with 30–33 dorsal setae, and 11–13 lateral setae (Fig. 2-F). Scutum without dorsomedian setae, with 107 or 112 dorsolateral setae on one side, and 27 or 30 supra-alar setae on one side. Scutellum with 88 setae in multiple rows, some arising from large pits and others from small pits (Fig. 3-D). Wing in Fig. 3-A and Table 2-1. Squama with 23 fringe setae. Anal lobe rather flat. Wing membrane slightly brown under reflecting light, thickly covered with numerous macrotrichiae. R 1 and R 4+5 closely set, R 2+3 absent. Costa slightly produced beyond tip of R 4+5. fCu slightly beyond r-m. Cu 2 almost straight. Relative length of leg segments in Table 3-1. fLR 0.74, mLR 0.44, hLR 0.49 (all smaller than in male). Front tibia with a long and sinuate terminal spur (53 microns; Fig. 3-E). Middle tibia with two relatively long, stout and sinuate terminal spurs (58 and 62 microns; Fig. 3-F). Hind tibia with a long terminal spur (88 microns), a shorter terminal spur (58 microns), and a terminal comb composed of 8 simple and separated spurs (60–80 microns; Fig. 3-G). Tarsi with relatively long beards, fBR 2.5, mBR 3.4, hBR 3.2. All legs with well developed claws, empodium and a pair of small pulvilli (Fig. 3-H). Spermathecae small and colorless, one 55×48 microns, the other 77×89 microns (Fig. 3-I). Cercus ear-shaped, 150 microns wide and 65 microns long (Fig. 3-J).

Pupa. Length of abdomen 3.16–4.38 mm (3.70 mm in average of 7). Color of pupal skin brown, with a narrow dark brown band along oral margin of abdominal tergites II–VI. Thoracic respiratory organs very short and spine-like with a few bards on the surface, 58–101 microns in length (89 μ in average of 7; Figs. 4-A, B). Distribution of spines, spinules and hairs on abdominal segments in Figs. 4-C, D. Segment I without spines and spinules. Tergite II with a large spinose area (II-a, b, c) covering almost the entire surface excepting the lateral parts, and a transverse band of large, recurved spines along the caudal margin (II-d), composed of 87–146 (108 in average of 7) spines arranged in double or triple rows, each spine measuring about 20 microns in length. Tergites II, III, IV and V with a large spinose area covering almost the entire surface (-a, b, c), and a band of numerous small recurved spines in multiple rows on the intersegmental membrane (-d). The spinose area on tergite VI is divided roughly into three parts, the basal part (VI-a) bearing small spines about 5 microns long, the middle part bearing longer spines about 12 microns in length (VI-b), and the caudal part bearing largest spines about 20 microns in length (VI-c), the intersegmental membrane is devoid of spines such as seen on segments IV–VI, but bears numerous spinules lateral and prealar setae on scutum, presence of numerous macrotrichiae on wing mem-

brane, by long and stout terminal spurs especially on middle tibia, etc. The pupa is characteristic in the structure of thoracic respiratory organs (Figs. 4-A, B), in the presence of strong spines along posterior margins of sternites VI, VII and VIII, and in the presence of three stout, hook-like but short setae and long, filamentous fringe hairs on the anal fins (Fig. 4-E). In the larva, especially characteristic are the structures of appendages of the labrum, the paired central teeth of mental plate, and the long and cylindrical basal tubercles of the anal hair tufts.

Tokunaga (1939) recorded two species of *Brillia* from Kyoto area, *B. modesta* (Meigen) and the present species. They can easily be differentiated by the relative length of the two arms of gonostylus, being almost equal in the former but the accessory one is conspicuously shorter than the main arm in the latter.

Brillia japonica is apparently a species whose larvae develop in relatively oligotrophic or unpolluted part of a river, and the present specimens were collected only from Station No. 1 in the summer survey, and from No. 2 and No. 3 in the winter survey of the Minamiasakawa River. A large number of males of this species were collected by the author in November 1976, while swarming on the bank of a mountain stream at Kubune, Kyoto, at the type locality of Tokunaga's original description.

(2) *Eukiefferiella tamaflavus*, sp. nov.

Materials studied. Holotype: a male, emerged on 20 August 1979 from a sample collected at Station No. 2, mounted in gum-chloral (No. A53:21). Paratypes: a male, same data (A53:22); two females, emerged on 20 August and 25 August from a sample of Stations No. 2 and 3, respectively (A53:26, 27); a male and a female emerged from a sample of No. 2, and a female emerged from a sample of No. 1, all fixed on pin. A male pupal skin collected 20 August from a sample of No. 3 (A53:28). A female pupa, dead just before emergence, collected 25 August from a sample of No. 3 (A53:30).

Male. Body length 1.66 and 1.68 mm. Wing length 1.08, 1.05 and 0.98 mm. Ground color of scutum yellow, scutal stripes brown, scutellum yellow, postnotum brown, halteres yellow, legs brownish yellow, abdominal tergites brown. Head as in Fig. 6-A. Antennal flagellum 13 segmented, AR 0.37 (holotype) and 0.38, apical segment with about 10 terminal sensory setae 20–23 microns long (Figs. 6-A, B). Palp 4 segmented (26, 55, 77, 118 microns). Eyes bare, widely apart from each other, reniform, dorsomedial process practically absent, ER 1.24 and 1.50. Clypeal setae 6. Supra-orbital setae 3 or 4 on each side.

Anteprepronotum well developed, with 2 lateral setae, dorsally bare. Scutum without dorsomedian setae, with 8 dorsolateral setae on each side, and with 3 supra-alar setae on each side. Median scutal stripes united in the middle. Scutellum with 4 or 5 setae in a single transverse row. Wing as in Fig. 8-A and Table 2-2. Squama with 4 setae. R 2+3 absent. fCu much beyond r-m (52%:41%). An not extending beyond fCu. Anal lobe of moderate size. Relative length of leg segments as in Table 3-2. fLR 0.86 and 0.89 (relatively high as a member of Orthocladinae), mLR 0.47 and 0.51 (relatively small), hLR 0.59 and 0.58. All femora and tibiae with long hairs; those on hind femur, for example, 85 microns long and 5.7 times the diameter of the segment, those on hind tibia 120 microns long and 12 times the diameter of the segment. Tarsus I also with relatively long hairs, fBR 2.8, mBR 3.2, hBR 4.6. Front tibia with a long apical spur 33 microns long (Fig. 6-C); middle tibia with two short apical spurs

20 microns and 23 microns long (Fig. 6-D); hind tibia with a long apical spur 40 microns long, a short apical spur 21 microns long, and an apical comb composed of 10 spurs 19–34 microns long (Fig. 6-E). Empodium well developed, pulvilli absent (Fig. 6-F).

Hairs on abdominal tergites are relatively few, and arranged roughly into the oral and the caudal transverse rows (Fig. 7-A). Hypopygium in Figs. 7-C, D. Ninth tergite with only 2 pairs of long setae near the lateral margins. Posterior margin of ninth tergite with a pair of rounded lobes. Anal point triangular, covered with microtrichiae excepting the apical portion, with a pair of long hairs on the lateral margin near the base (Fig. 7-B). Inner lobe of gonocoxite large and broad, with rounded margin, and with more than 10 long hairs and numerous microtrichiae. Gonostylus slender, about 25 microns long and 14 microns wide, with a stout apical spur, and a subapical seta arising from a tubercle (Fig. 6-G).

Female. Body length 1.70 and 1.89 mm in gum-chloral mounted specimens. Wing length 0.97–1.03 mm (1.00 mm in average of 4). Body coloration as in male, ground color of scutum yellow, scutal stripes brown, halteres yellow, scutellum brown, postnotum and abdominal tergites dark brown, legs yellowish brown. Head as in Fig. 8-B. Antenna composed of a pedicellum and 5 flagellar segments (34, 39, 24, 25, 27, 59 microns), last segment with about 10 sensory setae in the apical part (Fig. 8-C). Palpi 4 segmented (24, 48, 63, 96 microns). Eyes reniform, without dorsomedial projection and widely apart from each other, ER 1.13 and 1.07. Clepeal setae 6 and 9. Supraorbital setae 3 or 4 on each side. Dorsomedian setae absent, dorsolateral setae 7 or 8 on one side, supra-alar setae 2 or 3 on each side (Fig. 8-D). Scutellum with 4 setae in a transverse row. Wing venation as in Fig. 8-A and Table 2-2. Squama with 4 setae. R 2+3 absent. r-m strong and oblique. fCu much beyond r-m. Costa extending beyond end of R 4+5. An ending before end of fCu. fLR 0.77 and 0.80, mLR 0.49 and 0.50, hLR 0.55 and 0.58. Front tibia with a terminal spur 20 microns long (Fig. 8-E); middle tibia with two terminal spurs 17 and 15 microns long (Fig. 8-F), hind tibia with a long terminal spur 26 microns long, a short terminal spur 15 microns long, and a terminal comb composed of 9 spurs 26–17 microns long (Fig. 8-G). Pulvilli vestigial. Spermathecae in Fig. 8-H, both elongated and only slightly pigmented. Cercus (Fig. 8-I) shoe-shaped, with a long and pointed ventral projection, 70 microns long and 26 microns high, ratio 2.7.

Pupa. A male pupal skin measured body length of 1.92 mm and length of abdomen of 1.40 mm. A female pupa had abdomen 1.44 mm long. Coloration of pupal skin brown, darker than most other Orthoclaudiinae pupae. Thoracic respiratory organ 340 microns long and 25 microns wide at the widest part near the base in the male, 330 microns long and 24 microns wide in the female pupa, basally swollen like a bulb and apically tapering like a filament (Fig. 10-B). Distribution of hairs, spines and spinules on abdominal tergites in Fig. 9-A, those on sternites in Fig. 10-A. Tergites II to VIII with a basal spinulose area (II–VIII a), which increases in size by the order of segments, and a pair of spine patches composed of not more than 10 stout spines (Fig. 9-B). Tergite II without caudal band of large recurved spines (an unusual character as a chironomid pupa), but tergites III and IV with a pair of spine groups on the caudal margin, each composed of about 4 large recurved spines in a transverse row (III, IV d). Sternites II and III with a few small spines in the middle, IV to VIII with several large triangular and pale spines in a transverse row (IV–VIIIv; Fig. 10-C). Segments II to VIII all with 4 pairs of lateral hairs, among which the first pair on III to VII and the

second pair on VIII are long and simple (s-type), the rests all short and simple (s-type), but none of them are long and filamentous (L-type is absent); see Table 4, S-2). Anal segment with a pair of genital sheaths (longer in male than in female pupa), and a pair of long triangular anal fins bearing 3 long and stout setae on the tip (each about 0.17 mm long), and a long and filamentous seta on the dorsal side near the median edge (about 0.20 mm long; Figs. 9-C and 10-D).

Discussion. The genus *Eukiefferiella* was created by Thienemann (1926) based on the morphological characters of pupae, for those which have the thoracic respiratory organs basally swollen like a bulb, and apically tapering to a fine filament. The concept of this genus based on adult characteristics was given by Edwards (1929), and more in details by Brundin (1956). Reviews of this genus were made by Zavrel (1939) and Thienemann (1944) for larvae and pupae, and by Lehmann (1972) for pupae and adults of the European species. This genus apparently contains heterologous species in the adult morphology with a variety of combinations of different characteristics, such as with eyes bare or pubescent, with squama bare or fringed, etc. However, the present species fits quite well with the definition given by these authors, as the wings are without macro- and microtrichiae, fCu well beyond r-m, which is stout and oblique, M quite straight, Cu 1 straight and continuing the direction of Cu, and wing lobe is rounded. Among the known species of this genus, the present one is considered to be closest to *E. calvescens* (Edwards, 1929) known from Europe in the structure of wing, male hypopygium and body coloration; the wing vein R 2+3 appearing absent and completely fused with R 4+5, hypopygium with a triangular anal point and a broad and rounded inner lobe of gonocoxite, gonostylus is not expanded apically and without subapical tooth, and the value of AR is small. However, the present species differs from *E. calvescens* described by Lehmann (1972) in the still lower AR (0.37 in the present species, 0.6–0.8 in *E. calvescens*), in the number of long setae on anal point (2 in this species, 6 in *E. calvescens*), and in the number of sensory setae of antenna (about 10 in this species, 6 in *E. calvescens*).

The pupa described here is also closest to *E. calvescens* among those reviewed by Lehmann (1972), since it has a bulb-like thoracic respiratory organs, anal segment with 3 pairs of stout terminal setae and a pair of long inner setae on the anal fins, segments III and IV with about 4 pairs of large, recurved spines on the dorsal side near the caudal margin, and sternites IV–VII with a pair of spine groups separated in the middle along the caudal margin. However, this species differs from *E. calvescens* in that the recurved spines on the dorsal side near the anal margin are absent on segment V (this is present also on segment V in *E. calvescens*), the position from which the inner pair of long hairs arise is the type similar to that of *E. bavarica* than to *E. calvescens* (cf. Fig. 69 of Lehmann, 1972), and the 3 short spines found at the bases of terminal setae on anal fins found in *E. calvescens* are absent in the present specimen.

A total of 4 species apparently belonging to this genus were recorded from the Japanese region, *E. bicolor* (Zetterstedt) of Tokunaga (1938) from Kyoto, *E. takahashii* (Tokunaga, 1939) from Taiwan, *E. tentoriola* (Tokunaga, 1939) from Kyoto, and *E. yasunoi* Sasa, 1979, from Tsukuba. All of them differ from the present species in the absence of anal point of male hypopygium, and in a number of other morphological characters.

(3) *Synorthocladus tamapavulus*, sp. nov.

Materials studied. Holotype: a male (No. A53:31) emerged on 3 September 1979, from a sample collected at Station No. 3. Paratypes: 5 males (No. A53:32–36) all from Station No. 3, of which 4 emerged on 3 September and 1 on 29 August; 5 females (No. A53:41–45), of which 1 emerged on 29 August from Station No. 2, 3 on 3 September and 1 on 11 September from Station No. 3; all mounted in gum-chloral. 2 males and 3 females, fixed on pin, all from Station No. 3 on 3 September.

Male. Body length 1.84–2.00 mm (1.93 mm in average of 5). Wing length 1.08–1.24 mm (1.18 mm in average of 5). Ground color of scutum yellow, scutal stripes black (slightly brownish), scutellum brown, postnotum and abdominal tergites black, halteres yellow, legs yellow.

Head in Fig. 11-B. Antennal flagellum 13 segmented, AR 0.60–0.68 (0.64 in average of 6); last antennal segment slightly swollen apically, with 3 short and curved apical sensory setae about 33 microns long. (Fig. 11-C). Palpi 4 segmented (36, 56, 66, 121 microns). Eyes reniform, without dorsomedian projection and widely separated, 233 microns apart and 180 microns high, ER 1.30. Supraorbital setae 3 or 4 on each side, frontal setae 1 pair, clypeal setae 6 in a transverse row.

Thorax in Fig. 12-F. Anteprenotum narrowed in the middle, dorsally bare, and with 1 or 2 very weak lateral setae on each side. Scutum without dorsomedian setae, with 5 or 6 dorsolateral setae on one side, and 2–4 (most commonly 3) supra-alar setae on each side. Scutellum with 4 setae in a single row. Wing as in Fig. 11-A and Table 2-3. Wing membrane bare, slightly brown by transmitted light. R 2+3 ending at about middle between R 1 and R 4+5. Costa extending slightly beyond tip of R 4+5. fCu slightly beyond r-m, which is stout and oblique. Cu 1 ending nearly under tip of R 4+5. Cu 2 almost straight. Squama fringed with about 4 setae. Relative length of leg segments as in Table 3-3. fLR 0.58–0.63 (0.61 in average of 5), mLR 0.46–0.51 (0.49 in 5), hLR 0.50–0.54 (0.53 in 5), all relatively small. Tarsus 1 with relatively long hairs, fBR 3.0, mBR 5.8, hBR 3.9 in the type specimen. Front tibia with a long terminal spur 33 microns long; middle tibia with two short terminal spurs 16 and 13 microns long; hind tibia with a long and sinuous terminal spur 36 microns long, a short terminal spur 13 microns long, and a terminal comb composed of about 10 spurs 20–30 microns long (Figs. 12-G, H, I, J). Pulvilli absent (Fig. 12-K).

Abdominal tergites with relatively small numbers of hairs as in Fig. 11-F. Hypopygium in Figs. 12-A, B. Ninth tergite with about 5 pairs of short setae on the anterior and medial portion, and a small, triangular anal point (Fig. 12-C). Gonocoxite with double inner lobes, a dorsal conical lobe devoid of microtrichiae (Fig. 12-E), and a ventral, broad triangular lobe with several short hairs and numerous microtrichiae (Fig. 12-D). Gonostylus in Fig. 12-E, with a broad spatulated apical spur, and short apical and subapical setae.

Female. Body length 1.05–1.76 mm (1.39 in average of 5). Wing length 1.03–1.18 mm (1.10 mm in 5). Coloration as in male, ground color of scutum yellow, scutal stripes, postnotum and abdominal tergites dark brown, halteres yellow, legs yellowish brown. Head in Fig. 11-D. Eyes reniform, without dorsomedial projection and widely apart from each other, ER 1.1–1.5 (1.28 in 5). Antenna 6 segmented (39, 43, 32, 29, 31, 60 microns), the last segment with 4 long and curved sensory setae each about 43 microns long (Fig. 11-E). Frontal setae 1 on each side, supraorbital setae 3 or 4 on one side. Palp 4 segmented (31, 57, 58, 113 microns). Clypeal setae 7 in one and 6 in

four specimens.

Thorax in Fig. 11-L. Anteprenotum bare dorsally, with 1 or 2 very weak lateral setae. Dorsomedian setae absent, dorsolateral setae 5 or 6 on one side, supra-alar setae 2-4 on one side, scutellum with 4 (in 4) or 5 (in 1) setae. Wing as in Table 2-3 and Fig. 11-A. Squama with about 4 setae. Anal lobe produced and rounded. R 2+3 ending about middle of tips of R 1 and R 4+5. Costa slightly extending beyond tip of R 4+5. Cu 1 ending under tip of R 4+5. fCu beyond r-m. Length of leg segments in Table 3-3. fLR 0.58-0.64 (0.60 in 4), mLR 0.46-0.49 (0.48 in 4), hLR 0.52-0.54 (0.53 in 4), all relatively small. Front tibia with a terminal spur 22 microns long (Fig. 11-G); middle tibia with 2 short terminal spurs 15 and 19 microns long (Fig. 11-H); hind tibia with a long and sinuous terminal spur 46 microns long, a short terminal spur 15 microns long, and a terminal comb composed of 9 or 10 spurs 19-30 microns long (Fig. 11-I, J.). Claws with 2 basal hairs, empodium well developed, pulvilli absent (Fig. 11-K).

Abdominal tergites with relatively few hairs as in the male. Spermathecae oval, about 72 microns long and 54 microns in diameter, remarkably dark brown (darker than in the preceding species, and this is a useful character for differentiation of female of this species; Fig. 11-N). Cercus with a narrow and long ventral process (Fig. 11-M).

Pupa. 3 pupal exuviae (2 from No. 3 and 1 from No. 2), all not directly associated with adults but from morphological basis presumed to be those of *Synorthocladus tamaparvulus* n. sp., were mounted in gum-chloral for this study. Distribution of spines, spinules and hairs on abdominal segments in Fig. 13-A. Abdominal tergite II with a pair of small spinulous areas near the proximal margin (II-a), and a transverse band of large recurved but colorless spines on the intersegmental membrane (41, 47 and 52 in number of spines, about 20 microns long or less), spinulous area II-c absent. Tergites III to VIII all with a central spinulous area (III-VIII b), and a transverse spinose area along the caudal margin (III-VIII c), the size of spines extremely small in tergite III and IV, much larger in tergites V-VIII (Fig. 13-C). Last segment with a pair of triangular anal fins bearing one long and stout inner terminal seta (60, 63 and 72 microns long in 3 specimens examined), and two much shorter and thinner terminal setae (22, 24, 29 microns and 12, 14, 15 microns; Fig. 13-B). Abdominal segments II to VI with 3 pairs, VII and VIII with 4 pairs of lateral setae, all short and simple (s-type).

Discussion. Ecologically, this species is interesting in that the larvae were found mostly at Station No. 3, where the river is slightly polluted with sewage water, and that most of the adults emerged during 28 August and 11 September, about 20 days after the samples were collected. The morphological characters of adult of this species seem to fit best to the concept of the genus *Synorthocladus* defined by Brundinn (1956) and Pinder (1978), for which only one species is known from Europe and North America, *S. semivirens* (Kieffer) (= *Spaniotoma tripilata* Edwards). In the present species, eyes are bare, the last antennal segment bears 3 or 4 relatively long and curved subapical sensory setae both in male and female, hind tibia with a long, sinuated terminal spine and a very short terminal spine, pulvilli are absent, and hypopygium with a short and triangular anal point and a small conical inner lobe on the gonocoxite. This species, however, differs from *semiviridis* in the body size (wing length 2.2-2.5 mm according to Edwards, 1929), in the value of AR (0.8 according to the same author), in the absence of dorsomedial projection of eyes (Brundin, 1956, states: Augen dorsalwärts etwas verlängert), and in the number of hairs on squama (in *semiviridis*, about 9 according to Brundin, 1956). The structure of pupa, especially the unusual character of terminal

setae, is similar to that described by Thienemann (1944, p. 566 and Fig. 24) with *Synorthocladus* spp., though the spines at the tip of anal fins are absent in the present species.

(4) *Cricotopus bicinctus* (Meigen, 1818)

Altogether 31 males and 23 females were recovered from samples collected at Station No. 6, together with pupae and larvae, and a male was also collected from Station No. 5 of Minamiasakawa. This is apparently a species whose larvae develop in streams highly polluted with sewage waters. Morphology of adults, pupa and larva was already described in the previous paper (Sasa, 1979, p. 37, Plates 56-59).

(5) *Cricotopus sylvestris* (Fabricius, 1774)

This is again a common species breeding in streams highly polluted with sewage waters, and altogether 25 males and 19 females were recovered from samples collected at Station No. 6, but not from those of less polluted parts of the river. Description of adults, pupa and larva was also given in the previous paper (Sasa, 1979, p. 41, Plates 60-63).

The adults of *C. bicinctus* and *C. sylvestris* can most easily be differentiated by the coloration of legs and abdominal tergites; in the former, basal 2/3 of mid and hind femora are white, and abdominal tergites I, IV and VII are entirely white, while in the latter the femora are largely dark, abdominal tergites I and IV are white but VII is dark.

(6) *Cricotopus tricinctus* (Meigen, 1818)

Materials studied. A male (No. A54:91), emerged on 20 August 1979, from a sample collected at Station No. 5, mounted in gum-chloral. A female pupal skin presumably belonging to this species, collected also from a sample of No. 5 (A54:93).

Male. Body length 3.05 mm. Wing length 1.71 mm. Anteprenotum and ground color of scutum pale yellow, scutal stripes dark brown, median stripes long and extending from anterior to posterior margin of scutum (Fig. 15-A); scutellum and postnotum dark brown. Leg coloration in Fig. 15-E; front coxa yellow, middle and hind coxae brown, trochanters yellow; proximal half of all femora yellow, distal half brown; all tibiae with a long white ring in the middle, proximal 0.4 and distal 0.2 of front tibia, and proximal 0.2 and distal 0.2 of middle and hind tibiae dark; front tarsi all dark, tarsus I as well as proximal half of tarsus II of middle and hind legs pale, the rest parts of tarsi dark. Abdominal tergites I, IV and VII entirely white, tergites II, III, V and VI largely dark and with a narrow pale band along the proximal margin, tergites VIII and IX entirely dark, hypopygium white (Fig. 15-F).

Head as in Fig. 15-B. Antennal flagellum 13 segmented, AR 1.53; last segment with 10 curved subapical sensory setae (Fig. 15-C). Vertical setae 2 on each side, supra-orbital setae 3 on each side, clypeal setae 8. Palpi 4 segmented (48, 89, 106, 160 microns; Fig. 15-D). Eyes highly pubescent, with a conspicuous dorsomedial projection, ER 1.0.

Anteprenotum well developed, with 4 lateral setae on each side (Fig. 15-A). Scutum with 14 dorsomedian setae, 20 dorsolateral setae on each side, all short, decumbent and arising from small pits; prealar setae 2 on each side; scutellum with 7 setae (Fig. 15-A). Wing as in Fig. 14-A and Table 2-6. Squama with 8 fringe setae. Anal lobe well developed, rectangular. R 2+3 well separated from R 1 and R 4+5, ending about midway between ends of R 1 and R 4+5. Costa ending slightly beyond end of R 4+5. Cu 1 ending proximal to end of R 4+5. fCu much beyond r-m. An long, reaching to near end of Cu 2. Relative length of leg segments as in Table 3-6. Leg ratio relatively small, fLR 0.58, mLR 0.46, hLR 0.54. Front tibia with a long terminal spur 46 microns long; middle tibia with two short terminal spurs 28 and 26 microns long; hind tibia with a long terminal spur 47 microns long, a short terminal spur 24 microns long, and a terminal comb composed of 12 spurs 53–25 microns long (Figs. 14-F–I). Hairs on tarsi I relatively short, fBR 1.5, mBR 1.8, hBR 1.5. Pulvilli well developed (Figs. 14-B, C).

The setae on abdominal tergites II to VII are highly reduced in the numbers, and are arranged roughly into the median row of 3 or 4 setae, and lateral groups of 2–5 setae (Fig. 15-F). Hypopygium in Fig. 14-E. Ninth tergite without anal point, and with only 5 short setae in the middle. Inner lobe of gonocoxite almost conical, with 7 stout setae on the inner margin, and 6 setae on the basal portion (Fig. 14-D). Gonostylus stout, with a thick and apically rounded terminal spur (Fig. 14-E).

Pupa. A female pupal skin examined in the present study was differentiated from those of coexisting *C. bicinctus* firstly by the color being conspicuously paler in general. Length of abdomen 2.43 mm. Thoracic horns 143 and 133 microns long, with the maximum width of 22 microns, and with sparse spinules on the distal two thirds (Fig. 16-A). Distribution of spines and spinules on abdominal segments as in Fig. 16-B, C. Tergite and sternite I without spines and spinules. Tergite II without basal and central spinulose areas (II-a, II-b, II-c absent), and with a transverse band of large recurved spines in two rows along the caudal margin (II-d, composed of 54 spines each about 25 microns long); sternites II and III with a large spinulose area (II-v). Tergites III to VI with a central spinose area (III-b, IV-b, V-b, VI-b), and a caudal band of spines in multiple rows (III-c, IV-c, V-c, VI-c); in addition, tergites III and IV have a band of small recurved spines on the intersegmental membrane (III-d, IV-d); sternites IV, V and VI with a central spinulose area (IV-v, V-v, VI-v), and a caudal band of narrow and sharply pointed spines, whose lateral parts are whirl-like (IV-w, V-w, VI-w). Tergites and sternites VII, VIII and IX without spines, and each with spinulose areas. Segments II to VI with 3 pairs, and VII and VIII with 4 pairs of lateral hairs, all short and simple. Anal fins with 3 pairs of stout and hook-like terminal setae, which are almost equal in length and each about 165 microns long (Fig. 16-E).

Discussion. *Cricotopus tricinatus* (Meigen) is a species widely distributed in Europe (Hirvenoja, 1973), and was also recorded from Canada, and in U.S.A. (Sublette & Sublette, 1965). Tokunaga (1936, p. 14) stated that this species was commonly captured at light in Kyoto, and was also collected from Tokushima.

(7) *Cricotopus triannulatus* (Macquart, 1826)

Materials studied. Two males, recovered from samples collected at Station No. 5 of Minamiasakawa, on 21 and 23 August 1979 (Specimen No. A54:56 and 57). A pupal skin associated with the male.

Male. Body length 3.02 and 2.65 mm. Wing length 1.56 mm in the former. Antepronotum and ground color of scutum yellow, scutal stripes black, median stripes reaching only to middle of scutum, scutellum and postnotum black; front femur yellow basally, otherwise black, front tibia black at base and at apical 1/3, white at middle, front tarsi all black; middle and hind femora yellow at base and black at distal 3/4, tibiae white at middle 2/3, tarsi brown (distal 3 segments darker than the proximal 2 segments); abdominal segment I entirely yellow, II yellow at basal half and black at distal half, III entirely black, IV and V largely yellow with a narrow distal black band, VI, VII and VIII black, hypopygium white (Fig. 17-G).

Head as in Fig. 17-A. Antenna with 13 flagellar segments, AR 1.24 and 1.23, terminal segment slightly expanded apically and with several curved sensory setae (Fig. 17-B). Palp 4 segmented (51, 77, 123, 176 microns). Eyes highly pubescent, with a long dorsomedial projection, ER 0.87 and 0.70. Vertical hairs 1 on each side, supra-orbital hairs 4 on each side. Clypeal hairs 10 or 8.

Antepronotum well developed, with 4-6 weak lateral hairs on each side. Scutum with median stripes reaching to only the middle, with 12 or 14 dorsomedian setae and 10 or 12 dorsolateral setae on each side, which are all weak and decumbent, arising from minute pits; supra-alar setae 2 on each side. Scutellum with 6 setae. Relative length of leg segments in Table 3-7. LR 0.60 in the front, 0.46 in the middle, and 0.58 in the hind leg. Front tibia with a terminal spur 43 microns long; middle tibia with 2 short terminal spurs both 20 microns long; hind tibia with a long and sinuate terminal spur 56 microns long, a short terminal spur 20 microns long, and a terminal comb composed of 12 spurs 53-22 microns long (Figs. 17-C-F). Tarsi without long beards. Pulvilli vestigial (Fig. 17-G).

Abdominal tergites II to VI with highly reduced numbers of setae as in Fig. 17-H. Hypopygium in Fig. 17-K. Ninth tergite with 12 short setae in the middle. Anal point absent. Inner lobe of gonocoxite bifurcate, the inner arm bearing several stout setae (Figs. 17-I, J). Gonostylus broad and flat, with a spatulate terminal spur (Fig. 17-I).

Pupa (Description based on a pupal skin dissected from a dead pupa containing mature adult male, specimen No. A54:56). Length of abdomen 2.12 mm. Color of pupal skin brown, darker than in the related species. Thoracic respiratory horn short and spinose, length 91 or 87 microns, maximum width 21 or 19 microns (Fig. 18-A). Distribution of hairs, spines and spinules on abdominal segments in Fig. 18-B. Abdominal tergite II with a band of altogether 83 long recurved spines in two rows along the caudal margin (II-d), each about 25 microns long, and a central (II-b) and a caudal spinulose area (II-c) which are composed of very minute and rather easily overlooked spinules; sternite II with a small central spinulose area. Tergite III with a large central spinose area (III-b), a caudal spinose area (III-c), a band of small recurved spines in multiple rows (III-d) on the intersegmental membrane, and a pair of spinulose areas along the lateral margins; sternite III with a large central spinulose area (III-v), and a pair of small caudolateral spinulose areas (III-w). Tergites IV, V and VI each with a large central spinose area (IV-b, V-b, VI-b), a caudal spinose area (IV-c, V-c, VI-c),

and lateral spinulous areas, but devoid of a band of recurved spines on the intersegmental membrane such as seen on tergite III; sternite IV with a large central spinulous area (IV-v), a pair of whirl-like spinose areas in the caudolateral corners (IV-w); sternites V and VI with a pair of spinulous areas in the proximolateral corners, a spinulous area in the middle near the caudal margin, and a pair of whirl-like spinose areas in the caudolateral corners. Tergites and sternites VII and VIII with a proximal spinulous area (VII-a, -v; VIII-a, -v), Tergite IX with a proximal spinulous area. Anal lobes bear 3 strong terminal hairs of subequal length with recurved apex (each about 115 microns long, Fig. 18-E). The numbers of pairs of lateral hairs are 1 on abdominal segment I, 3 on segments II to VII (the second pair longer than the first and the third), and 5 on segment VIII (the second and forth are forked, Fig. 18-E).

Discussion. *Cricotopus triannulatus* (Macquart, 1826) is a species widely distributed in Europe, and the morphology of adults, pupa and larva was described in details by Hirvenoja (1973, pp. 208-211). Tokunaga (1936, p. 12) reported that this was a very common species found in the Kyoto area of Japan, and gave accounts on morphology of male and female. The small numbers of male and pupal skin cast collected at the present survey from a relatively polluted part (Station No. 5) of the river are identified tentatively as belonging to this species purely on morphological basis. Especially characteristic are the structure of male hypopygium, including the forked inner lobe of gonocoxite, and the body coloration including the presence of dark bands on the anal margins of abdominal tergites IV and V.

(8) *Cricotopus tamannulatus*, sp. nov.

Materials studied. Holotype: male, (A 54:51), emerged 25 August 1979. Paratype: female (A 54:52), emerged 23 August. A pupal skin cast (A 54:53), indirectly associated with the female. All from a sample of Station No. 1, the uppermost and least polluted part of the river.

Male. Body length 2.47 mm. Wing length 1.58 mm. Ground color of scutum yellow, scutal stripes black, scutellum and postnotum black, halteres yellow. Basal 1/3 of femora pale, distal 2/3 black; front tibia with a long white ring in the middle, basal 15% and distal 30% black; front tarsi all dark; middle and hind tibiae largely white excepting the proximal and apical ends being black; tarsi I and II of middle and hind legs pale brown, tarsi III, IV and V of middle and hind legs dark brown. Abdominal tergite I entirely white; proximal 2/3 of tergite II white, distal 1/3 black; proximal 1/4 of tergite III white, distal 3/4 black; proximal 2/3 of tergites IV and V white, distal 1/3 black; tergite VII white at oral half, black at distal half; tergites VI and VIII entirely black; hypopygium white.

Head in Fig. 20-A. Antenna with 13 flagellar segments, AR 1.16, terminal segment 427 microns long and with 12 curved sensory setae in the apical portion (Fig. 20-B). Palpi relatively long, 4 segmented (43, 75, 101, 190 microns). Eyes highly pubescent, with a long dorsomedial projection, 145 microns apart from each other and 21 microns high, ER 0.71. Supraorbital hairs 4 on each side. Clypeal hairs 14.

Anteprepronotum well developed, with 4 lateral setae on each side. Scutum with 14 weak and decumbent dorsomedian setae, 8 weak dorsolateral setae on each side all arising from small inconspicuous holes (a characteristic of this genus), and 3 supra-alar setae on each side (Fig. 19-B). Scutellum with only 2 setae. Wing in Fig. 19-A and

Table 2-8. Squama with 6 setae on each wing. R 2+3 separated from both R 1 and R 4+5. Tip of Cu 1 proximal to tip of R 4+5. fCu slightly apical of r-m. Cu 2 not strongly sinuate. Relative length of leg segments in Table 3-8. fLR 0.61, mLR 0.50, hLR 0.55. Hairs on legs relatively short, fBR 1.8, mBR 2.3, hBR 2.8. Claws, pulvilli and empodium well developed, (Fig. 20-C).

Abdominal tergites with highly reduced hairs as in Fig. 19-C. Hypopygium in Figs. 20-D, E. Ninth tergite without anal point, and with 9 short setae on both sides. Inner lobe of gonocoxite composed of a conical and a rectangular process (Figs. 19-G, H).

Female. Body length 2.45 mm. Wing length 1.34 mm. Coloration as in the male; ground color of scutum yellow, scutal stripes dark brown, median stripes reaching to only about middle of scutum; femora dark brown at distal 2/3 and paler at basal 1/3, tibiae widely pale in the middle and darker at both ends, tarsi dark brown; abdominal tergites I, IV and VII entirely yellow, II and V yellow at basal half and dark at caudal half, III, VI and VIII almost entirely dark, hypopygium white (Fig. 21-H).

Head as in Fig. 21-A. Antenna with a pedicellum and 5 flagellar segments (43, 63, 36, 37, 40, 99 microns), the last segment swollen in the middle, with 7 sensory setae (and probably with a terminal hair, which is missing in the specimen; Fig. 21-B). Palpi 4 segmented (41, 58, 91, 147 microns). Eyes densely pubescent, reniform, with only a slight dorsomedial projection, 1.95 mm high and 1.95 mm distant from each other, ER 1.0. Vertex with 2 pairs of setae, supraorbital setae 3 on each side, clypeal setae 16.

Scutum with 14 dorsomedian setae, and 16 dorsolateral setae on each side, all short, decumbent and arising from small holes, and 3 supra-alar setae on each side. Scutellum with 8 setae on a transverse row. Wing venation as in Fig. 19-A and Table 2-8. Squama with 4 fringe setae. An reaching much beyond fCu. Relative length of leg segments in Table 3-8; especially noteworthy is the long front tibia, which makes fLR as low as 0.51. Front tibia with a relatively short terminal spur 30 microns long bearing 2 barbs; middle tibia with 2 short terminal spurs 17 and 21 microns long; hind tibia with a long terminal spur 45 microns long, a short terminal spur 19 microns long, and a terminal comb composed of 14 spurs 22-46 microns long (Figs. 21-D-G). Pulvilli moderate in size. Abdominal tergites with highly reduced numbers of hairs (Fig. 21-H). Cercus 106 microns wide and 77 microns long, ear-like and with two posterior lobes (Fig. 21-J). Spermathecae brown, ovoid, 80 x 60 and 87 x 45 microns (Fig. 21-I).

Pupa. A pupal skin was recovered on the same day from the same container as the female adult. Length of abdomen 1.90 mm. Color brown, slightly paler than that of *Cr. metatitialis*. Thoracic respiratory organs simple horn-like, 166 microns long and 24 microns wide, widest near tip and with smooth surface (Fig. 22-A). Distribution of spines, spinules and hairs on abdominal segments in Fig. 22-B. Segment I without spines, spinules and lateral hairs. Tergite II with a band of small spines in the caudal zone (II-c), and a transverse band of large recurved spines (altogether 48, each about 25 microns long) in two rows along the caudal margin. Tergites III, IV and V with a central spinose area (III-b, IV-b, V-b), a caudal spinose area (-c), both clearly separated from each other, and a transverse band of small recurved spines (about 7 microns long) on the intersegmental membrane. Tergite VI with a central spinose area (VI-b), a caudal spinose area (VI-c), both separated from each other, but without spines on the intersegmental membrane. Tergites VII, VIII and IX with spinulose zones but without

spines. Sternites II to VIII with spinulose zones, among which those on II and III are united in the middle and the rests are separated in the middle. In addition, tergites V to VII with numerous narrow, colorless and sharply pointed spines in the caudolateral corners and along the caudal margin. The distribution of lateral hairs is 3 pairs on abdominal segments II to VI, 4 pairs on VII, and 5 pairs on VIII, all short and simple. Anal lobes with 3 stout and apically curved terminal setae of subequal length, each measuring about 130 microns (Fig. 22-D).

Discussion. This species is very similar, especially in adult morphology, to *Cricotopus triannulatus* collected from the lower and more polluted parts of the same river, and there still exists some doubt about whether this species is really independent from it, because the number of specimens studied here were very small. Males of the two populations are closely related in the coloration of thorax, legs and abdominal tergites, and can be separated from related *Cricotopus* species in that abdominal tergites IV and V are largely white but with a black band along the caudal margin. The structure of male hypopygium is also closely related to *C. triannulatus*, especially in that inner lobe of gonocoxite is forked into a conical arm bearing stout setae and a proximal rectangular process bearing numerous shorter setae (Figs. 17-I, J; 19-G, H). However, this population is considered here as different from *C. triannulatus* in that abdominal tergite VII is largely white in the male (entirely white in the female specimen), in the shape of gonostylus (being stouter in the present species), and by the size of pulvilli (larger in the present species). The structure of pupa described here as that of the present species (not directly associated with the adult specimen, but was co-existing in the same lot) is quite different from that of *C. triannulatus* described in this paper (and also from the European specimens given by Hirvenoja, 1973, p. 208) in the size of thoracic respiratory organs (much longer in this species), in the absence of spinose areas on tergite II, in the absence of whirl-like spinose areas on sternite III in the present species (they are present on sternites III to VI in *triannulatus*, only on IV to VI in most other species of Orthocladinae), and in the numbers of lateral hairs on segments VII and VIII (3 and 5 in *triannulatus*, 4 and 4 in the present species),.

(9) *Cricotopus metatibialis*, Tokunaga, 1936

Materials studied. 4 males, mounted in gum-chloral (A 54:61-64); a male, fixed on pin; 2 females, mounted in gum-chloral (A 54:65, 66); 6 pupal exuviae indirectly associated with the adults (A 54:53, 69). All recovered on 22 and 23 August 1979 from a sample collected at Station No. 1.

Male. (Description based on 3 specimens mounted in gum-chloral). Body length 2.24, 2.26 and 2.29 mm. Wing length 1.30, 1.28 and 1.37 mm. Ground color of scutum yellow, scutal stripes separated, dark brown, reaching to only middle of scutum; scutellum brown, postnotum dark brown, halteres white. Leg coloration in Fig. 25-B. Front femur brown and darker at distal 1/4; front tibia largely white, narrowly brown at proximal and distal ends; front tarsi entirely dark brown; middle and hind femora brown at basal half and dark brown at distal half; middle tibia brown at basal end, white at basal half, and brown at distal half; hind tibia brown at basal end, dark brown in the middle, and brown at distal 1/3; middle and hind tarsi all dark brown. Abdominal tergites I, IV and VII entirely yellow; tergite II yellow at basal half and dark brown at

caudal half; tergite V yellow at basal 1/3 and dark brown at caudal 2/3; tergites III, VI and VIII largely dark, with a narrow pale band along the basal margin; hypopygium white (Fig. 25-A).

Head in Fig. 23-A. Antenna with 13 flagellar segments, AR 1.00, 0.97 and 0.97. Palpi 4 segmented (31, 63, 84, 130 microns). Eyes highly pubescent, reniform, slightly extending dorsomedially, ER 0.68, 0.85 and 0.87. Vertex with 1 or 2 pairs of setae. Supraorbital setae 2, 3 or 4 pairs. Clypeal setae 11 or 10.

Thorax in Fig. 23-G. Antepronotum well developed, with 2 or 4 weak lateral setae. Dorsomedian setae 18, 14 or 12, dorsolateral setae 12, 11 or 10 on each side, all weak and decumbent, the pits from which they arise are small. Supra-alar setae 2 or 3 on each side. Scutellum with 8 setae in a transverse row. Wing venation in Fig. 24-A and Table 2-9. Squama with 4, 5 or 6 hairs. Anal lobe nearly rectangular. R 2+3 ending about midway between tips of R 1 and R 4+5. fCu slightly beyond r-m. Relative length of leg segments in Table 3-9. fLR 0.63, 0.64 or 0.66, mLR 0.50, 0.51 or 0.54, hLR 0.56 or 0.57. Front tibia with a long terminal spur 38 microns long (Fig. 23-C). Middle tibia with two short terminal spurs 17 and 21 microns long (Fig. 23-D). Hind tibia with a long terminal spur (48 microns), a short terminal spur (18 microns), and a terminal comb composed of 20-43 microns long (Fig. 23-E). Tarsi without long beards. Pulvilli vestigial (Fig. 23-F).

Abdomen with highly reduced numbers of hairs (Fig. 25-A). Hypopygium (Fig. 23-I) without anal point, ninth tergite with a pair of conical lobes in the middle on the posterior margin, with a transverse row of 6 short hairs in the middle and 4-6 long hairs in the lateral corners. Gonocoxite without inner lobe (Fig. 23-H). Gonostylus with a large spatulate terminal spur, and a triangular subapical process. Inner margin of gonocoxite as in Fig. 23-H.

Female. (Description based on 2 gum-chloral mounted specimens and a dry preserved specimen for coloration). Body length 2.26 and 2.45 mm. Wing length 1.31 and 1.32 mm. Coloration generally as in male. Ground color of scutum yellow, scutal stripes dark brown, scutellum brown, postnotum dark brown. Wing membrane slightly brown by transmitted light. Front femur brown at basal half and paler at distal half; front tibia largely white, narrowly brown at basal and apical ends; front tarsi brown. Middle and hind femora brown; middle tibia largely white; hind tibia and all tarsi of middle and hind legs brown. Abdominal tergites I and IV entirely yellow, VII largely yellow excepting the caudal margin, II yellow at basal 1/3, III, V, VI and VIII entirely dark brown, cerci white.

Head as in Fig. 24-C. Antenna with a pedicellum and 5 flagellar segments (45, 51, 36, 37, 39, 101 microns; Fig. 24-B); terminal segment with a long terminal seta 58 microns long, and 5 curved sensory setae. Palpi 4 segmented (24, 58, 84, 135 microns). Eyes densely pubescent, slightly extended towards the middle, ER 1.0 and 1.2. Vertex with 1 or 2 pairs of setae. Supraorbital setae 3 on each side. Clypeal setae 16.

Antepronotum with 2-4 weak lateral setae. Scutum with 10 or 12 dorsomedian setae, and 14-16 dorsolateral setae on each side, all short and arising from minute pits (Fig. 24-D). prealar setae 3 on each side. Scutellum with 8 or 10 hairs. Wing in Fig. 24-A and Table 2-9. Squama with 4-6 fringe hairs. R 2+3 separated from both R 1 and R 4+5, ending midway between their tips. fCu slightly beyond r-m. Costa extending beyond tip of R 4+5. fLR 0.59 or 0.60, mLR 0.49 or 0.50, hLR 0.54 or 0.56. fBr 1.4, mBR 1.9, hLR 1.4. Pulvilli vestigial (Fig. 24-E). Abdominal tergites

with highly reduced numbers of setae (Fig. 25-F). Cercus ear-like, 94 microns wide and 36 microns long, Fig. 24-F. Spermathecae dark brown, 84 x 55 microns and 77 x 56 microns, Fig. 24-G.

Pupa. Length of abdomen 1.47–1.79 mm (1.64 ± 0.11 in measurements of 6). Color of exuviae brown. The presence of strongly pigmented lateral hairs on abdominal segments VI, VII and VIII, two pairs of stout terminal seta and a pair of weaker terminal seta on anal lobes, and the absence of spines on tergite II are diagnostic characters of this species.

Thoracic respiratory organs short and simple, horn-like and with pointed apex, surface smooth, 79–89 microns long and 8–11 microns wide (80 microns in average of 6 pairs; Fig. 26-A). Distribution of spines, spinules and lateral hairs on abdominal tergites in Fig. 26-B. Segment I without spines and spinules. Tergite II with double rows of strong, recurved spines (about 25 microns long) on the intersegmental membrane along the caudal margin (II-d), but otherwise free of spines and spinules on the tergite surface. Tergites III, IV and V with a broad central spinose area (a), a wider but shorter spinulose area along the caudal margin (c), and a transverse band of double rows of small recurved spines on the intersegmental membrane (d). Tergites VI, VII and VIII with a central spinose area and a caudal spinose area, but devoid of transverse band of recurved spines on the intersegmental membrane. Anal tergite with a large basal spinulose area. Sternites II and III with a large central spinulose area. Sternites IV–VIII with a pair of lateral spinulose areas. Segment II with 3 pairs and segments III to VIII with 4 pairs of lateral hairs (this is also an unusual character); the 4th pair of segments III–VI forked into 2–4 branches (Fig. 26-D); the 2nd and 3rd pair of segment VII as well as all of 4 pairs of segment VIII are long, stout and darkly pigmented. Anal lobes with 3 terminal setae, of which the inner one is thin, colorless and short (about 70 microns), the middle and outer ones long, stout, dark and curved like a hook (110 microns long; Fig. 26-E).

Discussion. Morphological characters of the males and females examined here agree quite well with the description of *Cricotopus metatibialis* of Tokunaga (1936), who stated it to be common in Kyoto area. This species apparently belongs to group B of genus *Cricotopus* in the sense of Edwards (1929), as it has distinct white rings on tibia, hypopygium being white, and pulvilli are absent. According to the key to species of *Cricotopus* prepared by Hirvenoja (1973) and Pinder (1978), it is obviously a member of the *trifascia* group because inner lobe of gonocoxite is absent. Among the two species known from Europe, the present species is closer to *similis* than to *trifascia* in the size of pale ring of front tibia and in the highly reduced chaetotaxy of abdominal tergite. Tokunaga (1936), in his original description of *C. metatibialis*, also pointed out that it most closely resembled to *C. similis* but differed in coloration of abdomen and tibia. According to Edwards (1929) and Pinder (1978), vein An does not reach beyond fCu in *C. similis*, but An extends well beyond fCu in the present species.

Pupa has been unknown both for *C. similis* and *C. metatibialis*. The pupa of *metatibialis* newly described here is closely related to that of *C. trifascia* given by Hirvenoja (1973, p. 246) in the size and structure of thoracic horn, in the distribution of spines and spinules on abdominal tergites, in the presence of strong lateral hairs on segment VIII, in the presence of unusually strong spines on anal tergite, and in that the inner pair of terminal setae on anal lobes being weaker and shorter than the middle and lateral pairs.

(10) *Cricotopus tamasimplex*, sp. nov.

Materials studied. Holotype: male, emerged 23 August 1979, from a sample collected at Station No. 3 (A 54:81).

Male. Body length 3.41 mm. Wing length 1.95 mm. Antepronotum and ground color of scutum yellow, scutal stripes dark brown, median stripes reaching to only middle of scutum, scutellum and postnotum black; femora dark (slightly paler near base), tibiae with a broad pale ring in the middle and dark at base and apex (Fig. 27-F), front tarsi entirely dark brown, middle and hind tarsi brown; abdominal tergites I and IV entirely white, tergites II, III, V, VI and VII largely black but with a broad pale band along the oral margin, tergite VIII entirely black, hypopygium white (Fig. 28-D).

Head in Fig. 27-B. Antenna with 13 flagellar segments, shaft relatively stout, AR 1.43, with several curved sensory setae near apex of last segment (Fig. 27-C). Palp 4 segmented (58, 89, 116, 186 microns). Eyes highly pubescent, with a conspicuous dorsomedial projection, ER 0.83. Supraorbital setae 3 on each side. Clypeal setae 13.

Thorax in Fig. 27-D. Antepronotum with 3 weak lateral setae on each side. Scutum with 16 dorsomedian setae and 14 dorsolateral setae on each side, all weak and decumbent, arising from small pits; supra-alar setae 3 on each side. Scutellum with 8 setae. Wing venation in Fig. 27-A and Table 2-10. Squama with 10 fringe hairs. R 2+3 separated from both R 1 and R 4+5 and ending about middle of the latter two veins. fCu nearly under r-m. An reaching far beyond fCu and ending at about middle of Cu 2. Relative length of leg segments in Table 3-10. fLR 0.68, mLR 0.53, hLR 0.61. Front tibia with a long terminal spur 53 microns long, middle tibia with two short terminal spurs 29 and 27 microns long, hind tibia with a long and sinuate terminal spur 58 microns long, a short terminal spur 27 microns long, and a terminal comb composed of 12 spurs 56–31 microns long (Figs. 27-G J). Tarsi without long beards, fBR 1.42, mBR 1.08, hBR 1.85. Pulvilli absent (Fig. 27-E).

Abdominal tergites II to VI with highly reduced setae (Fig. 28-D). Gonocoxite of abdominal tergites peculiar to this species. Hypopygium in Figs. 28-A, B. Ninth tergite with 12 short setae in the middle. Anal point absent, posterior margin of ninth tergite with a pair of setigerous lobes and a central groove (Fig. 28-B). Gonocoxite without inner lobe, and with a setigerous area bearing some 10 long and stout setae in the inner side (Figs. 28-B, C). Gonostylus with a strong spatulate apical spur, and a subapical swelling.

Discussion. Morphological characteristics of male of the present species indicate that it belongs to the *trifascia* group of genus *Cricotopus*, subgenus *Cricotopus* s. str. of Hirvenoja (1973), since it has neither anal point nor inner lobe of gonocoxite, its abdominal tergites I and IV are entirely pale and the rest of abdominal tergites are largely dark, and pulvilli are absent. Of the two species of this group known from Europe, the present species is closer to *C. trifascia* Edwards than to *C. similis* Goetghebuer, because the vein An extends much beyond fCu and to about half way along vein Cu 2. However, the present species differs from both of the European species in the coloration of abdominal tergites (tergites II, III, VI, VII and VIII are entirely dark in the European species but they all have a broad basal pale band in the present species) and in the value of AR (1.51–1.79 in *trifascia*, 1.04–1.25 in *similis*, and 1.43 in the present species). *C. metatibialis* Tokunaga is another member of this group and was also recorded from Station No. 1 of this river, but differs from the present species in the coloration of abdominal tergites and of the leg segments.

(11) *Paratrichocladius tamaater*, sp. nov.

Materials studied. Holotype: male, emerged 25 August 1979 from a sample collected 17 August at Station No. 1, dissected and mounted in gum-chloral (No. A 53:01). Paratypes: 3 males and a female (Nos. A 53:01–05), mounted in gum-chloral; a male and a female, fixed on pin, all emerged from samples collected at No. 1. Other specimens: 3 pupal exuviae associated with paratypes; a male and its pupal skin, recovered from a sample collected at Station No. 3 on 17 August; 2 males, recovered from a sample collected at Station No. 2 on 12 December 1979 (No. A 53:09).

Male. Body length 2.53–2.82 mm (2.66 mm in average of 6). Wing length 1.50–1.68 mm (1.60 mm in average of 7). Scutum, scutellum and postnotum almost uniformly shining black, scutal stripes black and hardly distinguishable from ground color of scutum. Halteres yellow, abdominal tergites shining black, excepting basal portions of tergites II to VII which are slightly paler. Legs almost uniformly dark brown.

Head in Fig. 29-A. Antenna with 13 flagellar segments, the terminal segment bears several curved sensory setae near the tip (Fig. 29-B). AR 1.05–1.26 (1.14 in average of 4). Eyes highly pubescent, with a long dorsomedial projection, ER small (0.42–0.62; 0.53 in average of 4). Palp 4 segmented (46, 84, 104, 178 microns). Vertical setae 1 or 2 on each side, postorbital setae 6 on each side. Clypeal setae 8 to 13, most commonly 10.

Thorax in Fig. 29-C. Antepronotum well developed, bare dorsally, and with 4–6 lateral setae on each side. Scutum with 8 to 11 short and decumbent dorsomedian setae, which are about 20 microns long, and with 11–17 (most commonly 12) long and stout dorsolateral setae (each about 50 microns long) on each side, all arising from large and pale pits; supra-alar setae 3 or 4 on each side. Scutellum with 10–14 setae (most commonly 10) in a transverse row. Wing unmarked, slightly brown, without macrotrichiae. Squama fringed with about 10 setae. Anal lobe moderately produced. Wing venation in Fig. 29-D and Table 2-12. R 2+3 ending about midway between tips of R 1 and R 4+5. Costa slightly produced beyond tip of R 4+5. fCu beyond r-m. M ending at tip of wing. Cu 2 only slightly curved. Legs almost uniformly brown. Relative length of leg segments in Table 3-12. Front tibia 1.3 times as long as front femur. Middle tibia about equal as long as middle femur. Hind tibia 1.2 times as long as hind femur. fLR 0.58–0.62 (0.60 in average of 6), mLR 0.47–0.51 (0.49 in average of 6), hLR 0.55–0.58 (0.57 in average of 6). Tarsi I without long beards, fBR 2.1, mBR 2.4, hBR 3.2. Front tibia with one long terminal spur 44 microns long (Fig. 29-E); middle tibia with two short terminal spurs 22 and 20 microns long (Fig. 29-F); hind tibia with a long terminal spur 55 microns long, a short terminal spur 21 microns long, and a terminal comb composed of about 10 spurs 22–48 microns long (Fig. 29-G). All legs with small pulvilli, and a well developed empodium.

Distribution of hairs on abdominal segments in Fig. 30-A; those on tergites II to VII highly reduced, and arranged roughly in the three groups, the oral transverse row, the caudal transverse row, and a pair of lateral longitudinal rows. The numbers of hairs in the oral, caudal and lateral groups in the type specimen are 5, 12 and 3 in tergite II, 4, 12 and 4 in tergite III, 4, 10 and 4 in tergite IV, 4, 8 and 5 in tergite V and VI, and 7, 6 and 5 in tergite VII.

Hypopygium in Fig. 30-B. Anal point absent, ninth tergite with 5 or 6 short setae about the middle. Gonocoxite roughly triangular, inner lobe composed of a conical dorsal process bearing about 10 setae and a low ventral process bearing numerous

microtrichiae (Figs. 30-C, D, E). Gonostylus with a conspicuous subapical lobe, a stout and flat apical spur, and two relatively strong accessory spurs (Figs. 30-E, F).

Female. Body length 2.05 mm. Wing length 1.61 mm. Coloration as in the male but generally paler; ground color of scutum brown, scutal stripes dark brown, scutellum and postnotum dark brown, halteres yellow, leg segments almost uniformly brown but apical half of femora darker than the rest parts. Abdominal tergites largely dark brown, tergites II to VI with a narrow pale band along the oral as well as the caudal margin.

Head in Fig. 31-C. Eyes highly pubescent, reniform and slightly projecting towards the middle, 160 microns distant from each other and 225 microns high, ER 0.72. Antenna (Fig. 31-B) composed of a pedicellum and 5 flagellar segments (46, 77, 36, 36, 87 microns), the first segment with double rows of hairs, the last segment tapering towards the tip and bears a subapical seta 58 microns long and several curved sensory setae. Palp 4 segmented (48, 72, 101, 195 microns; Fig. 31-A). Vertical setae 2 or 3 on each side, postorbital setae 4 on each side, clypeal setae 13.

Thorax in Fig. 31-D. Scutum with 8 short and decumbent dorsomedian setae (each about 25 microns long), 14 and 15 stout dorsolateral setae (each about 50 microns long) all arising from a large pale pit. Antepronotum bare dorsally, with 4 lateral setae on each side. Scutellum with 6 setae in a transverse row. Wing venation in Fig. 29-D and Table 2-11. Relative length of leg segments in Table 3-11; fLR 0.60, mLR 0.48, hLR 0.56, all slightly smaller than in male. Front and hind tibiae about 1.2 times as long as femora of the same leg, middle tibia almost as long as middle femur. Front tibia with a short terminal spur (25 microns), middle tibia with two short terminal spurs 19 and 20 microns long, hind tibia with one long spur (50 microns), one short spur (19 microns), and a comb composed of 10 or 11 spurs 25–42 microns long. Pulvilli vestigial, represented by a few short hairs.

Hairs on abdominal tergites highly reduced, as in the male, and those on tergites II to VII are arranged roughly into the three groups, the oral transverse row, the caudal transverse row, and the lateral longitudinal row. The numbers of hairs belonging to these groups are also characteristic to female of this species, 8, 12 and 3 or 4 in tergite II, 6, 14 and 6 in III, 4, 10 and 4 in IV-m 4, 8 and 4 in V and VI, 4, 8 and 3 in VII. Spermathecae are unusually long and sack-like, length 150 and width 46 microns (Fig. 31-E). Cercus ear-like, 104 microns wide and 70 microns long.

Pupa. Length of abdomen 2.03–2.26 mm (2.11 mm in average of 3, significantly shorter than 3.00–3.42 mm, or 3.17 mm in average of 8 of *Paratrachocladus rufiventris* of Tsukuba). Thoracic respiratory organs simple, tube-like, apically rounded, 0.18–0.20 mm long (0.19 mm in average of 3 pairs), with relatively few small spurs on middle one third of the tube (Fig. 32-A). Distribution of spines and spinules on abdominal segments as in Fig. 32-B. Tergite I and sternite I without spines and spinules. Tergite II, 6, 14 and 6 in III, 4, 10 and 4 in IV, 4, 8 and 4 in V and VI, 4, 8 and 3 in VII. Spermathecae are unusually long and sack-like, length 150 and width 46 microns (Fig. 31-E). Cercus ear-like, 104 microns wide and 70 microns long.

Number of spines 49, 52 and 57 in 3 specimens examined; sternite II with a large but diffuse spinulose zone. Tergite III, IV and V with a central spinose area (III-a, IV-a, V-a), a caudal spinose area (III-c, IV-c, V-c), and a band of small (about 5 microns long) recurved spines in 1–4 transverse rows on the intersegmental membrane (III-d, IV-d, V-d). In addition, tergites IV and V with a pair of small spinulose areas in the caudolateral corners. Tergite VI with a pair of oral spinulose areas, a central spinose

area (VI-b), a caudal spinose area (VI-c), but devoid of caudal band of recurved spines. Tergites VII, VIII and IX without spinose areas, and with a broad spinulose zone as in Fig. 32-D. Sternites II to VIII with spinulose zones; in addition, sternites IV, V and VI with a band of narrow spines along the caudal margin. The numbers of pairs of lateral hairs are 3 with segments II to VI, 4 with VII, and 5 with VIII, all simple and relatively short. Anal fins with 3 pairs of stout and hook-like setae of subequal length, each measuring about 190 microns (Fig. 32-E).

Discussion. The present species seems to belong to the genus *Paratrachocladus* Santos Abreu 1918 in the sense of Hirvenoja (1973), because eyes are pubescent, squama is fringed with hairs, wings are bare and unmarked, anal point is absent, gonostylus is simple, and dorsolateral setae on scutum are arising from distinct pale pits. According to Hirvenoja (1973), two species of this genus are known from Europe, and two from Nearctic Region, two from Ethiopian Region, and one from Australia. The present species is closely related to the European species *P. rufiventris* (Meigen), which was also recorded by Sasa (1979) as breeding abundantly in artificial streams constructed in this laboratory in NIES. The structure of male hypopygium is similar to that of *P. rufiventris* drawn by Hirvenoja (1973), Brundin (1956), Pinder (1978) and Sasa (1979). However, the inner lobe is apparently simple and conical in *P. rufiventris*, while that in the present species is two-lobed (Fig. 30-D). The most distinctive characteristics is the number of segments of female antenna (7 segmented in *P. rufiventris*, 6 in the present species). The distribution of setae on abdominal tergites II to VII in both sexes is also quite different between the two species, more numerous and irregularly arranged in *P. rufiventris* (Fig. 52-D of Sasa, 1979). Body size and wing length is significantly larger in *P. rufiventris*. AR is higher in *P. rufiventris* (1.35–1.63, 1.46 in average of 6).

In the pupa, the morphological characteristics of the present species is similar to that of *P. rufiventris* of Tsukuba; thoracic respiratory organs are not distinguishable by length, shape and distribution of spinules. The pattern of distribution of spines and spinules on abdominal tergites and sternites is also quite similar and different from other related Orthocladinae species; in both species, tergite II without central spinose areas (II-a and II-b absent); tergites III, IV and V with a large central spinose area, a large caudal spinose area, and numerous small recurved spines on the intersegmental membrane; tergite VI with a central spinose area (VI-b), caudal spinose area (VI-c), but devoid of spines on intersegmental membrane (VI-d absent); the length of three pairs of strong hook-like hairs on anal lobes are also similar in size. However, the body size is significantly smaller in the present species (length of abdomen 2.03–2.26 mm in the present species, 3.00–3.42 in *P. rufiventris*). The numbers of spines in the corresponding spine groups are generally larger in *P. rufiventris*; for example, spines of II-d are 49, 52 and 57 in the present species, and 95–109, or 104.1 ± 3.9 in measurements of 8 in *P. rufiventris*; caudal group of spines on tergite VI is 16, 30 and 34 in the present species, but 79, 85 and 99 in *P. rufiventris*. Some of the 5 pairs of lateral hairs on segment VIII are forked in *P. rufiventris* (Fig. 54-E of Sasa, 1979), but all of them are simple in the present species (Fig. 32-E).

(12) *Nanocladus tamabicolor*, sp. nov.

Materials studied. A total of 56 males and 57 females were reared from samples collected at Stations No. 4, 5 and 6 of the Minamiasakawa River (fairly to highly

polluted portions), among which 23 males, 10 females and 16 pupae were mounted in gum-chloral (No. A 54:01–23; 31–38; 41–49), and the rests are preserved dry, or in alcohol. A male and a female were recovered also from samples collected 12 December 1979 at Stations No. 6 and No. 4, respectively (No. 54:25, 26).

Male. Small midge with body length of 1.61–1.97 mm (1.80 ± 0.12 mm in measurements of 10) and wing length of 1.00–1.21 mm (1.09 ± 0.07 mm in 10). Antennal hairs white (a distinguishing character for this species), scutum, scutellum and postnotum almost uniformly black, scutal stripes hardly distinguishable, abdominal tergites black, sternites I–III white, IV–VII with a large dark spot; basal half of femora dark, leg segments otherwise pale yellow.

Head in Fig. 34-A. Antennal flagellum 13 segmented, AR 0.60–0.82 (0.71 ± 0.06 in measurements of 10); terminal segment swollen apically, with about 10 short subapical sensory setae each approximately 45 microns long (Fig. 34-B, C). Palpi 4 segmented (43, 67, 96, 145 microns). Eyes strongly convex and highly pubescent, small and pyriform, without dorsomedial projection and widely apart from each other, ER 1.60–2.00 (1.78 in average of 8). Supraorbital setae only 1 or 2 on each side. Clypeal setae 8–12 (most frequently 8).

Anteprepronotum well developed, medially separated, and with 2 or 3 weak lateral setae on each side. Scutum with only 2 dorsomedian setae closely set and arising from the same pit, 4 (rarely 5 or 6) dorsolateral setae in a single row and arising from large pale pits, and 1 (rarely 2) supra-alar setae on each side. Scutellum usually with only 2 setae (2 of 10 specimens had 3 scutellar setae; Fig. 34-D). Wing colorless, without macro- and microtrichiae. Relative length of wing venation in Fig. 33-A and Table 2-12. Squama with 3–5 hairs. R 2+3 fused with R 4+5 (such as in some *Eukiefferiella*). Costa produced slightly beyond tip of R 4+5. Tips of R 4+5 and Cu 2 almost on the same level. fCu beyond r-m, which is distinct and oblique. Anal lobe rounded. Cu 2 almost straight. Relative length of leg segments in Table 3-12. fLR 0.61–0.68 (0.65 ± 0.02 in measurements of 10), mLR 0.47–0.50 (0.482 ± 0.015 in 10), hLR 0.52–0.58 (0.557 ± 0.021 in 10). Front tibia with a narrow, long and sharply pointed terminal spur 42 microns long (Fig. 34-E), middle tibia with two short terminal spurs 16 and 14 microns long (Fig. 34-F), hind tibia with one long (36 microns) and one short (17 microns) terminal spurs, and a terminal comb composed of 10 spurs 19–27 microns long (Fig. 34-G). Femora, tibiae and tarsi of all legs with relatively long hairs, fBR 2.7, mBR 2.9, hBR 4.9. Pulvilli well developed like in *Psectrocladius* (Fig. 34-H).

Abdominal tergites with highly reduced numbers of setae, tergite I usually with only 3 pairs, tergites II to VII with 4 pairs of setae (Fig. 34-D). Hypopygium in Figs. 35-A, B. Anal point narrow, slender and with sharply pointed apex; anal tergite with 3–5 (usually 4) short setae in a transverse row near base of anal point (Fig. 35-C). Inner lobe of gonocoxite single, roughly rectangular, with about 10 stout and rigid setae (Fig. 35-D). Gonostylus slender, apically curved inwards and not expanded, with a large spatulate apical spur about 8 microns long and 3 microns wide (Fig. 35-D).

Female. Coloration similar to male, but paler (yellowish) in general; ground color of scutum yellow, scutal stripes brown, scutellum, postnotum and abdominal tergites dark brown; halteres yellow, leg segments yellow excepting tibiae and basal parts of femora which are largely brown. Body length 0.92–1.45 mm (1.23 ± 0.16 mm in measurements of 8). Wing length 0.97–1.05 mm (1.01 ± 0.01 mm in 8). Head as in Fig. 33-B. Antenna with a pedicellum and 5 flagellar segments (53, 48, 29, 34, 32, 87 microns; Fig. 33-C); the last segment darker than the preceding segments, and with

about 10 strong setae. Palpi 4 segmented (36, 55, 87, 140 microns). Eyes highly pubescent, pyriform and strongly convex, without dorsomedial projection and widely apart from each other, ER 1.46–2.78 (1.80 in 8). Supraorbital setae 1 (rarely 2) on each side. Clypeal setae 7–12 (most frequently 10, 9.6 in average of 8).

Thorax in Fig. 34-D. Antepronotum dorsally bare, with 1 or 2 very weak lateral setae. Scutum with 2 dorsomedian setae situated in about the middle and arising from a common pit, 5–8 (most commonly 6) dorsolateral setae on each side, and 1 or 2 (more commonly 1) supra-alar setae on each side. Scutellum with 2–4 (most commonly 2) setae. Wing venation in Fig. 33-A and Table 2-11. Wing membrane bare and smooth, colorless. Squama with 3–4 setae. R 2+3 fused with R 4+5. Costa extending beyond tip of R 4+5. Tip of Cu 1 almost under tip of R 4+5. fCu beyond r-m. Cu 2 almost straight. Anal lobe rounded. Relative length of leg segments in Table 3-11. fLR 0.57–0.63 (0.595 in average of 8), mLR 0.43–0.46 (0.443 in average of 8), hLR 0.51–0.56 (0.535 in average of 8). Front tibia with a long and sharply pointed terminal spur 24 microns long, middle tibia with 2 short terminal spurs 10 and 15 microns long, hind tibia with a long sinuated and barbed terminal spur 27 microns long, a short terminal spur 13 microns long, and a terminal comb composed of some 10 spurs 16–30 microns long. Pulvilli well developed. Spermathecae ovoid, dark brown (Fig. 33-E). Cercus 53 microns wide and 38 microns long (Fig. 33-F).

Pupa. Length of abdomen 1.27–1.57 mm (1.44 mm in average of 10 exuviae). Thoracic respiratory organs horn-like, 157–195 microns long (179±13 microns in 10 pairs), widest near the base and gradually tapering towards very thin and needle-like tip, and with a few weak barbs on the surface (Fig. 35-E). Two out of the three humeral setae and the two pronotal setae adjacent to thoracic respiratory organs are stout and arise from large semiglobular bases (Fig. 35-E). Distribution of setae, spines and spinules on abdominal tergites I–VI in Fig. 36-A, and tergites VII–IX in Fig. 36-C. Segment I with a pair of stout lateral setae arising from a large base, a pair of stout setae in the middle of tergite also arising from a large base, and 3 pairs of short setae on tergite. Segment II with 3 pairs of stout lateral setae (II-t) and a pair of inner setae all with large bases, and posterior lobe bearing large triangular spines along the caudal margin (II-c), but without spines on intersegmental membrane. Segment III with 3 pairs of lateral setae (III-t) arising from large semiglobular bases, a transverse row of narrow and sharply pointed spines along the caudal margin of tergite, and a row of smaller spines on the intersegmental membrane (III-c, III-d). Segment IV with 3 pairs of stout lateral hairs arising from large bases, several small spines in the middle of tergite (IV-b), and a transverse row of sharply pointed spines along the caudal margin of tergite (IV-c). Segments V and VI with 3 pairs of weak lateral hairs arising from small bases, a central spinose and spinulous area and a row of narrow and sharply pointed spines along the caudal margin of tergite (V-b, V-c; VI-b, VI-c). Segment VII with 4 pairs of long, filamentous lateral hairs, and a large central spinulous area both on tergite and sternite, but devoid of large spines. Segment VIII with 5 pairs of long filamentous lateral hairs, a pair of spinulous areas on tergite, and a pair of long setae on tergite. Anal lobes with a spinulous zone near the oral margin, and each fringed with 15–19 (most frequently 16) long filamentous hairs, and 3 long and filamentous (not stout and rigid as in most other Orthocladinae pupae) caudal hairs; the frequency by the number of fringe hairs in observation of 11 pairs being 2, 12, 2, 4, and 2 for 15, 16, 17, 18 and 19, respectively.

Discussion. The genus *Nanocladus* Kieffer, 1913, has been frequently referred

by many authors by the generic name of *Microcricotopus* Thienemann et Harnisch, 1932, but Freeman (1956) and Saether (1977) regarded the latter as a synonym of the former. The generic status was discussed in details by adult morphology by Goetghebuer (1944) and Brundin (1956), or by pupal and larval morphology by Thienemann and Harnisch (1932) and Thienemann (1944). A review of the genus was made by Fittkau and Lehman (1970), and more recently by Saether (1977). The present species is very closely related in adult morphology to *Nanocladius bicolor* (Zetterstedt, 1843), which is a species widespread in Europe, and was recorded also by Tokunaga (1938) from Kyoto. The present species as well as *N. bicolor* is characterized by the eyes being small and highly pubescent, absence of R 2+3 of wing vein, the peculiar chaetotoxy of setae on scutum and scutellum, the presence of pulvilli and a sharply pointed anal point, and by the inner lobe of gonocoxite being broader than in the other species of this genus. However, the present species is apparently different from European *bicolor* in the shape of gonostylus (apically narrowed and curved inwards in the present species, apically expanded and truncate in *bicolor*), in the arrangement of setae on abdominal tergites II–VII (on a transverse line in the present species, irregular in *bicolor* according to Fittkau and Lehmann, 1970), in the shape of inner lobe of gonocoxite (more rounded in the present species), and in the numbers of long hairs at the base of anal point (3 or 4 in the present species, 14 in *bicolor* according to Brundin, 1956, Fig. 86). In the pupa, the shape of thoracic respiratory organs is also similar to that of *bicolor* and quite different from other related species, but the spines on tergite II are much stouter and arise from a peculiar lobe in the present species (those on II and III are almost the same in *bicolor* according to Fittkau and Lehmann, 1970), and the filamentous fringe hairs on anal fins are 15–19 (usually 16) in the present species, while those are 23–30 in the European *bicolor*. In the key compiled by Saether for species of the genus *Nanocladius*, the present species can also be separated from *bicolor* by the arrangement of setae on abdominal tergites (irregularly double on all tergites in *bicolor*), and from all the other species either by the value of AR, number and arrangement of setae on tergites and scutellum, or by the structure of anal point and inner lobe of gonocoxite. It is possible that the species described by Tokunaga (1938, p. 319) from Kyoto by the name of *Spaniotoma* (*Eukiefferiella*) *bicolor* is the same as the present new species.†

(13) *Parametriocnemus stylatus* (Kieffer, 1924)

Materials studied. A male, emerged on 29 August from a sample of Station No. 2, dissected and mounted in gum-chloral (A 53:51); 2 males from Station No. 1, a male from No. 2, and 4 males from No. 3 (A 53:52–58); 3 females from No. 1 and a female from No. 2; (A 53:61–64); a female from No. 3 fixed on pin. Two male pupal exuviae and 2 female pupal exuviae associated with adults (A 53:66–69). A larval head capsule attached to a female pupal exuviae (A 53:66). Two males and a female were recovered also from Station No. 3 at the winter survey.

Male. Body length 2.13–2.63 mm (2.33 mm in average of 7). Wing length 1.34–1.42 mm (1.38 mm in average of 8). Antennal shaft and hairs dark brown, eyes black, ground color of scutum yellow, scutal stripes dark brown, scutellum largely yellow but dark brown along the oral margin, postnotum dark brown, wing milky white, halteres entirely yellow, legs almost uniformly brown, abdomen dark brown.

Head in Fig. 37-B. Antennal flagellum 13 segmented, AR 0.79–0.95 (0.88 in average of 6); apical segment of antenna with 4 long, curved subapical setae (Fig. 37-E). Palpi 5 segmented (24, 31, 72, 101, 150 microns; the first segment ill defined, without setae and narrow). Eyes bare, with a long dorsomedial projection, ER 0.33–0.38 (0.36 in average of 7). Supraorbital setae 8–10 on each side. Clypeal setae 9–11.

Thorax in Figs. 37-I, J. Antepronotum well developed, bare dorsally, with 5–7 lateral setae. Scutum with 13–16 dorsomedian setae, 11–15 dorsolateral setae on both sides all arising from pale pits, and 3–5 supra-alar setae on both sides. Scutellum with an uniserial row of 6–10 (most frequently 6) setae. Wing venation in Fig. 37-F and Table 2-13. Squama with 4 or 5 setae. Wing membrane with macrotrichiae as in Fig. 37-F. R 2+3 running close to R 4+5. Costa extending much beyond tip of R 4+5. R 4+5 and Cu 1 ending on the same level. Cu 2 remarkably sinuous. fCu nearly under r-m. Relative length of leg segments in Fig. 39-A and Table 3-13. fLR 0.74–0.77 (0.75 in average of 7), mLR 0.55–0.59 (0.57 in average of 7), hLR 0.63–0.66 (0.64 in average of 7). Front tibia with a simple terminal spur 41 microns long (Fig. 38-F), hind tibia with a long spur 43 microns long, a short spur 16 microns long, and a terminal comb composed of some 11 spurs 33–42 microns long (Figs. 38-G, H). Pulvilli absent (Fig. 38-I).

Abdominal tergites with numerous setae irregularly distributed as in Fig. 39-B. Hypopygium in Figs. 38-A, B. Anal point robust, about 50 microns long and 30 microns wide at the base, triangularly shaped but with rounded apex, covered with microtrichiae on the basal 2/3 and with several short lateral hairs (Fig. 38-D). Gonocoxite with a broad and roughly rectangular inner lobe, bearing many microtrichiae and about 10 short hairs. Gonostylus rather slender, apically truncate, with a stout apical spur (Fig. 38-C).

Female. Body length 2.00–2.58 mm (2.23 mm in average of 4). Wing length 1.26–1.47 mm (1.36 mm in average of 5). Body coloration generally paler than in male; antenna brown, ground color of scutum yellow, scutal stripes reddish brown, scutellum yellow postnotum brown, wings unmarked, halteres pale yellow, legs brownish yellow, abdomen brown.

Head in Fig. 37-A. Antenna with a pedicellum and 5 flagellar segments (82, 75, 48, 48, 51, 70 microns; Fig. 37-D), each segment relatively short and thick, the first segment with double rows of hairs. Palp 5 segmented (29, 41, 87, 111, 210 microns; Fig. 37-C). Eyes with a dorsomedial projection, which is shorter than in male, ER 0.36–0.48 (0.43 in 4). Supraorbital hairs 8 on each side in all specimens examined. Clypeal hairs 10, 12, 14 and 14 in the 4 specimen.

Thorax in Fig. 37-H. Antepronotum well developed, with 5–7 (usually 5) lateral hairs on each side. Scutum with 10, 12, 14 and 20 (very variable) dorsomedian setae all short and decumbent, 20–26 dorsolateral setae on both sides (more numerous than in male, partly in two rows; Fig. 37-H), and usually 5 (rarely 6) supra-alar setae; scutellum with 8 or 10 setae on a single transverse row. Wing venation in Fig. 37-F and Table 2-13. Wing membrane with macrotrichiae more densely distributed than in male. R 2+3 very close to R 4+5. Costa extending beyond tip of R 4+5. fCu almost under r-m. Cu 2 remarkably sinuous. Squama fringed with 5–7 hairs. Anal lobe rather flat. Relative length of leg segments in Table 3-13. fLR 0.72–0.75 (0.73 in average of 4), mLR 0.52–0.55 (0.537 in 4), hLR 0.60–0.62 (0.615 in 4). Front tibia without terminal spur (Fig. 37-M); middle tibia with two short terminal spurs 21 and 18 microns long (Fig. 37-N); hind tibia with a long terminal spur 48 microns long, a short terminal

spur 17 microns long, and a terminal comb composed of 10 spurs 46-24 microns long (Figs. 37-O, P). Claws and empodium well developed, pulvilli absent (Fig. 37-M). Cercus ear-shaped, about 77 microns wide and 48 microns long, ratio 1.60 (Fig. 37-K). Spermathecae in Fig. 39-D.

Pupa. Length of abdomen 1.95 and 2.08 mm in 2 male pupal exuviae, and 1.84 and 1.97 mm in 2 female pupal exuviae. Thoracic respiratory organs (Fig. 41-A) horn-like, widest at about apical 1/3, apically rather rounded, 262-282 microns long (273 microns in average of 4 pairs) and 40-44 microns wide, with small spinules almost on the entire surface.

Distribution of spines and spinules on abdominal tergites and sternites in Figs. 40-A, B. Tergite I with a pair of transverse bands of small spinules on the caudal part. Sternite I with a pair of broader spinulose areas in the middle part. Tergite II with two pairs of spinulose areas in the oral part, and a transverse band of small spines in the caudal part; the caudal transverse band of long recurved spines is absent. Sternite II with oral, central and caudal spinulose areas. Segment II with a pair of long lateral processes. Tergites III to VIII with a large central spinulose area, and a caudal transverse band of large rounded or triangular spines; in addition, tergites III to VI with a pair of lateral spinulose areas near the oral margin. Sternites III to VIII (in male pupa) or sternites III to VII (in female pupa) with an oral spinulose area, and a caudal band of large spines; in addition, sternites III and IV with a pair of lateral longitudinal spinulose areas. Sternite VIII of female pupa without spines and spinules, but with a pair of triangular and longitudinally divided tubercles (Fig. 41-B). Anal tergite with a central spinulose area. Segments II to VII with 3 pairs of short and simple lateral hairs. Segment VIII with 3 pairs of long and simple lateral hairs. Anal fins each with 6, 7 or 8 long and filamentous hairs on the lateral margin, 3 stout and curved terminal hairs about 170 microns long, and several small spines in the terminal portion. (Figs. 41-B, C).

Larva (head capsule only): Head capsule 243 microns long and 380 microns wide (compressed specimen). Antenna 5 segmented (36, 15, 8, 7, 5 microns; Fig. 41-G); segment I about as long as the combined length of segments II to V; ring organ near base of segment I; antennal blade 29 microns long and 0.86 times as long as the combined length of segments II to V. Mandible (Fig. 41-F) 100 microns long and 44 microns wide with 4 cutting teeth, and with a conspicuous tubercle on the outer margin near the base. Labial plate with 12 teeth, the central pair not paler than the lateral pairs, the second and the third pairs almost as wide as the central pair and wider than the more lateral 3 pairs; the fifth pair is longer and more produced than the fourth and the sixth pairs (Fig. 41-D). Labrum and epipharynx in Fig. 41-E; premandible with two teeth. Maxilla in Fig. 41-H.

Discussion. This species is a typical member of genus *Parametriocnemus*, because wing membrane has numerous macrotrichiae, gonostylus of male being simple, wing vein Cu 2 is strongly curved, eyes are bare and those of male with a long and narrow dorsomedial projection, and male hypopygium with a robust anal point and with a conspicuous inner lobe on gonocoxite. Basic structure of pupa and larva of this species also fits quite well with those reported for European and American species of this genus. The morphology of adults, pupa and larva of the present species is most closely related to that of *Parametriocnemus stylatus* (Kieffer), though it is possible that more detailed studies with additional materials will elucidate some essential difference between the European and the Japanese populations. The present population belongs probably to the same species as that described by Tokunaga (1939, p. 307) under the name of *Metriocnemus* (*Parametriocnemus*) *stylatus* Kieffer by males collected at Kyoto.

Table 2. Standard measurements of wing venation

Code No.	Species	Sex	WL (mm)	Percentage to wing length												
				ww	Rs	Sc	R1	R2+3	R4+5	Cs	M	Cu1	Cu2	An	r-m	fCu
1.	<i>Brillia japonica</i>	M	2.32	26	16	57	81	—	97	99	97	89	79	53	49	51
		F	2.40	29	15	53	78	—	97	99	96	86	67	51	42	44
2.	<i>Eukiefferiella tamaflavus</i>	M	1.02	29	15	53	63	—	86	91	99	90	70	44	41	53
		F	0.93	31	15	50	59	—	91	94	99	93	72	46	41	52
3.	<i>Synorthocladus tamaparvulus</i>	M	1.17	27	14	56	67	77	89	93	99	87	71	61	47	51
		F	1.03	34	15	52	63	79	89	94	99	89	68	56	40	47
6.	<i>Cricotopus tricinctus</i>	M	1.71	26	16	59	70	83	91	94	99	87	70	61	50	56
8.	<i>Cricotopus tamannulatus</i>	M	1.58	25	14	56	72	83	94	94	99	88	72	58	47	50
		F	1.34	31	14	57	72	82	93	96	99	89	71	58	49	53
9.	<i>Cricotopus metatibialis</i>	M	1.30	27	15	54	73	83	93	96	99	89	70	57	50	53
		F	1.31	31	15	61	73	83	93	97	99	89	68	54	46	51
10.	<i>Cricotopus tamasimplex</i>	M	1.95	28	15	56	72	83	93	96	99	88	71	58	50	51
11.	<i>Paratrithocladus tamaater</i>	M	1.65	25	15	54	69	80	93	96	99	89	70	55	45	51
		F	1.52	30	15	53	69	80	93	96	99	89	70	55	46	49
12.	<i>Nanocladius tamabicolor</i>	M	1.16	27	14	59	70	—	89	94	99	89	71	58	52	56
		F	1.05	33	14	53	62	—	90	95	99	88	68	50	45	50
13.	<i>Parametriocnemus stylatus</i>	M	1.40	24	15	54	67	85	90	96	99	90	76	47	49	51
		F	1.38	29	15	52	67	85	87	96	99	87	72	45	46	47

Table 3. Standard measurements of legs

No.	Species	Sex	Leg		Length in 0.01mm unit						Ratios	
			No.	fe	ti	t1	t2	t3	t4	t5	LR	BR
1	<i>Brillia japonica</i>	M	1	77	93	77	39	30	22	12	0.82	3.4
			2	82	80	40	23	19	13	11	0.50	5.8
			3	86	96	52	33	29	18	11	0.55	4.0
		F	1	99	120	89	46	34	25	15	0.74	2.5
			2	104	101	45	27	22	14	11	0.44	3.4
			3	106	122	60	37	34	19	11	0.49	3.2
2	<i>Eukiefferiella tamaflavus</i>	M	1	36	34	29	21	15	10	7	0.86	2.8
			2	37	37	17	10	7	5	5	0.47	3.2
			3	37	40	23	13	11	6	6	0.59	4.6
		F	1	29	29	22	14	10	6	6	0.77	1.6
			2	30	29	14	8	7	3	4	0.49	0.8
			3	32	32	17	10	8	4	5	0.55	0.7
3	<i>Synorthocladus tamapavulus</i>	M	1	52	48	29	26	18	12	7	0.61	3.0
			2	42	40	20	14	10	7	6	0.50	5.8
			3	47	49	26	17	14	8	8	0.54	3.9
		F	1	46	39	22	19	14	9	7	0.58	2.7
			2	36	34	17	11	8	6	6	0.49	4.4
			3	37	41	22	14	11	6	6	0.52	3.1
6	<i>Cricotopus tricinctus</i>	M	1	62	79	46	26	19	14	10	0.58	1.5
			2	63	68	31	17	13	10	9	0.46	1.8
			3	65	77	42	22	18	11	9	0.54	1.9
7	<i>Cricotopus triannulatus</i>	M	1	60	73	44	24	17	14	9	0.60	2.1
			2	56	59	27	15	12	9	7	0.46	1.9
			3	56	65	38	19	14	10	8	0.58	1.7
8	<i>Cricotopus tamannulatus</i>	M	1	56	70	43	23	17	14	9	0.61	1.8
			2	60	57	29	15	12	9	8	0.50	2.3
			3	58	65	36	19	16	9	8	0.55	2.8
		F	1	50	67	34	19	13	11	7	0.61	1.1
			2	46	47	22	13	9	6	6	0.48	1.3
			3	46	51	29	21	12	7	7	0.58	1.4
9	<i>Cricotopus metatibialis</i>	M	1	49	57	38	21	16	11	8	0.66	1.6
			2	49	47	25	14	11	6	6	0.54	2.1
			3	46	52	29	15	12	7	7	0.57	2.0
		F	1	50	56	35	19	13	9	7	0.62	1.3
			2	53	48	23	19	9	7	6	0.49	1.6
			3	47	52	30	16	13	7	6	0.57	1.5
10.	<i>Cricotopus tamasimplex</i>	M	1	69	85	60	30	22	15	11	0.70	1.4
			2	58	72	38	20	16	11	10	0.53	1.3
			3	71	81	50	26	19	12	11	0.61	2.1

Table 3. (Continued)

No.	Species	Sex.	Leg	Length in 0.01mm unit							Ratios	
			No.	fe	ti	t1	t2	t3	t4	t5	LR	BR
11	<i>Paratrichocladus tamaater</i>	M	1	58	74	46	29	22	16	10	0.62	2.5
			2	64	62	31	17	14	9	8	0.50	2.5
			3	59	70	41	22	18	11	9	0.58	3.5
		F	1	54	65	39	24	17	13	10	0.60	1.7
			2	57	57	27	15	12	8	8	0.48	2.0
			3	58	66	37	19	14	9	8	0.56	2.2
12	<i>Nanocladus tamabicolor</i>	M	1	35	42	27	24	16	10	6	0.65	2.7
			2	34	35	16	11	8	5	4	0.47	3.9
			3	46	45	24	14	11	7	6	0.52	4.2
		F	1	28	34	21	13	10	7	6	0.61	1.6
			2	29	31	14	8	7	4	4	0.44	1.9
			3	30	34	19	10	8	5	5	0.56	1.8
13	<i>Parametriocnemus stylatus</i>	M	1	56	63	47	25	18	13	8	0.75	3.0
			2	55	51	28	13	11	6	6	0.56	4.0
			3	56	62	38	19	16	8	7	0.62	3.8
		F	1	58	62	45	23	16	12	8	0.75	1.7
			2	58	54	28	14	9	6	5	0.52	2.0
			3	58	62	38	18	14	8	9	0.62	2.2

Explanation of Table 4

A system for comparison of pupal chaetotaxy proposed by Sasa (1980, p. 52). S or W in the code number indicates the pupa is described either in Part 3 (summer survey) or Part 4 (winter survey).

TRO: Character of thoracic respiratory organs, whether spine-like, horn-like, cube-like, divided into numerous filaments (n) such as in *Chironomus*, or branched into 6 or 4 tubes such as in some *Polypedilum*. Lateral hairs on abdominal segments II to VIII are each expressed by the abbreviation: s (simple, short hair), S (simple, long hair); f (forked hair); L (long, flat and filamentous hair). Cl: Characters of caudolateral scales on abdominal segment VIII, whether absent (-), or with 1, 2, 3 or numerous spines. FH: Number of fringe hairs on anal fins; (-) indicates they are absent. TB: Character of terminal bristles on anal fins: H (long and hook-like seta); S (simple seta); L (long and filamentous seta); - (absent).

Table 4. Comparison of pupal chaetotaxy

Code No.	Species	TRO	II	III	IV	V	VI	VII	VIII	CL	FH	TB
S-1	<i>Brillia japonica</i>	spine	ssss	ssss	ssss	ssss	ssss	LLLL	LLLLL	—	18—31	HHH
S-2	<i>Euk. tamaflavus</i>	bulb	Ssss	Ssss	Ssss	Ssss	Ssss	Ssss	sSss	—	—	S+LLL
S-3	<i>Syn. tamaparvulus</i>	none	sss	sss	sss	sss	sss	ssss	ssss	—	—	Hhh
w-1	<i>Orth. tamanitidus</i>	horn	sss	sss	sss	sss	sss	ssss	ssss	—	—	HHH
w-2	<i>Orth. tamaputridus</i>	horn	sss	sss	sss	sss	sss	ssss	ssss	—	—	HHH
w-3	<i>Orth. yugashimaensis</i>	horn	sss	sss	sss	sss	sss	ssss	ssss	—	—	HHH
w-4	<i>Orth. tamarutilus</i>	horn	sss	sss	sss	sss	sss	sss	ssss	—	—	HHH
S-6	<i>Cric. tricinctus</i>	horn	sss	sss	sss	sss	sss	ssss	ssss	—	—	HHH
S-7	<i>Cric. triannulatus</i>	horn	sSs	sSs	sSs	sSs	sSs	sSs	sssss	—	—	HHH
S-8	<i>Cric. tamannulatus</i>	horn	sss	sss	sss	sss	sss	ssss	ssss	—	—	HHH
S-9	<i>Cric. metatibialis</i>	horn	sss	sssf	sssf	sssf	sssf	sSSs	SSSS	—	—	sHH
w-8	<i>Cric. tamadigitatus</i>	horn	sss	sss	sss	sss	sss	ssss	ssss	—	—	HHH
w-9	<i>Cric. tamapullus</i>	horn	sss	sss	sss	sss	sss	sss	ssss	—	—	HHH
w-14	<i>Parakief. tamatriang.</i>	ovoid	ssss	ssss	ssss	ssss	ssss	Ssss	Ssss	—	—	HHH
S-11	<i>Paratrach. tamaater</i>	horn	sss	sss	sss	sss	sss	ssss	sssss	—	—	HHH
S-12	<i>Nanocl. tamabicolor</i>	horn	SSS	SSS	SSS	sss	sss	LLLL	LLLLL	—	15—19	LLL
S-13	<i>Parametr. stylatus</i>	horn	sss	sss	sss	sss	sss	sss	SSS	—	6—8	HHH
w-10	<i>Rheocr. tamahumeralis</i>	horn	sss	sss	sss	ssss	ssss	LLLL	LLLLL	—	10—12	LLL
w-19	<i>Dicrot. tamaviridis</i>	n	sss	sss	sss	LLLL	LLLL	LLLL	LLLL	1	38	—
w-20	<i>Polyped. kobotokense</i>	?	sss	sss	sss	LLL	LLL	LLLL	LLLL	2	25—30	—
w-21	<i>Polyped. asakawaense</i>	6	sss	sss	sss	LLL	LLL	LLLL	LLLL	n	30—34	—

EXPLANATION OF PLATES AND FIGURES

(1) *Brillia japonica* Tokunaga, 1939

Plate 1. Adult male. A. head, frontal view. B. tip of natenna. C. thorax, lateral view. D, E. tip of hind tibia. F. tip of front tibia. G. tip of middle tibia. H. front tarsus I. I. hind tarsus I.

Plate 2. Adult. A. male hypopygium, dorsal view. B. male hypopygium, ventral view. C. male hypopygium, showing inner margins of gonocoxite. D. inner lobe of gonocoxite, dorsal view. E. gonostylus. F. anteprenotum, female

Plate 3. Adult. A. wing, male and female. B-J. body parts of adult female. B. head, frontal view. C. antenna. D. scutum and scutellum of thorax, dorsal view. E. tip of front tibia. F. tip of middle tibia. G. tip of hind tibia. H. front tarsus I. I. spermathecae. J. cercus.

Plate 4. Pupa. A, B. thoracic respiratory organ and associated setae. C. abdominal segments I-VIII, lateral view. D. parts of spinose or spinulose areas on abdominal segments. E. abdominal segments VIII and IX, dorsal view.

Plate 5. A-H. Larva, I. Pupa. A. labial plate. B. labrum, dorsal view. C. labrum, premandible and epipharynx. D. maxilla. E. antenna and mandible. F. claws on anterior pseudopod. G. bases of preanal hair tufts. H. spines and claws on posterior pseudopod. I. terminal setae on anal fin, pupa.

(2) *Eukiefferiella tamaflavus*, sp. nov.

Plate 6. Adult male. A. head. B. tip of antenna. C. tip of front tibia. D. tip of middle tibia. E. tip of hind tibia. F. front tarsus V. I. inner lobe of gonocoxite, and gonostylus.

Plate 7. Adult male. A. abdominal tergites, showing bases of setae. B. anal point. C. hypopygium, dorsal view. D. hypopygium, ventral view.

Plate 8. Adult. A. wing, male and female. B-I. female; B. head. C. antenna. D. thorax, lateral view. E. tip of front tibia. F. tip of middle tibia. G. tip of hind tibia. H. spermathecae. I. cercus.

Plate 9. Pupa. A. dorsal view of abdominal tergites. B. enlarged views of spinose areas. C. terminal segment, left half.

Plate 10. Pupa. A. abdominal sternites. B. thoracic respiratory organ and associated setae. C. spines on abdominal sternites IV to VIII. D. terminal segment, ventral view.

(3) *Synorthocladus tamiapavulus*, sp. nov.

Plate 11. Adult. A. wing, male and female. B. head, male. C. tip of male antenna. D. head, female. E. female antenna. F. abdominal tergites of male showing bases of setae. G. tip of front tibia. H. tip of middle tibia. I, J. tip of hind tibia. K. front tarsus I. L. thorax, dorsal view, female. M. cercus. N. spermathecae.

Plate 12. Adult male. A. hypopygium, dorsal view. B. hypopygium, ventral view. C. anal point and tip of ninth tergite. D. inner lobe of gonocoxite, ventral view. E. inner

EXPLANATION OF PLATES AND FIGURES

(1) *Brillia japonica* Tokunaga, 1939

Plate 1. Adult male. A. head, frontal view. B. tip of natenna. C. thorax, lateral view. D, E. tip of hind tibia. F. tip of front tibia. G. tip of middle tibia. H. front tarsus I. I. hind tarsus I.

Plate 2. Adult. A. male hypopygium, dorsal view. B. male hypopygium, ventral view. C. male hypopygium, showing inner margins of gonocoxite. D. inner lobe of gonocoxite, dorsal view. E. gonostylus. F. anteprenotum, female

Plate 3. Adult. A. wing, male and female. B-J. body parts of adult female. B. head, frontal view. C. antenna. D. scutum and scutellum of thorax, dorsal view. E. tip of front tibia. F. tip of middle tibia. G. tip of hind tibia. H. front tarsus I. I. spermathecae. J. cercus.

Plate 4. Pupa. A, B. thoracic respiratory organ and associated setae. C. abdominal segments I-VIII, lateral view. D. parts of spinose or spinulose areas on abdominal segments. E. abdominal segments VIII and IX, dorsal view.

Plate 5. A-H. Larva, I. Pupa. A. labial plate. B. labrum, dorsal view. C. labrum, premandible and epipharynx. D. maxilla. E. antenna and mandible. F. claws on anterior pseudopod. G. bases of preanal hair tufts. H. spines and claws on posterior pseudopod. I. terminal setae on anal fin, pupa.

(2) *Eukiefferiella tamaflavus*, sp. nov.

Plate 6. Adult male. A. head. B. tip of antenna. C. tip of front tibia. D. tip of middle tibia. E. tip of hind tibia. F. front tarsus V. I. inner lobe of gonocoxite, and gonostylus.

Plate 7. Adult male. A. abdominal tergites, showing bases of setae. B. anal point. C. hypopygium, dorsal view. D. hypopygium, ventral view.

Plate 8. Adult. A. wing, male and female. B-I. female; B. head. C. antenna. D. thorax, lateral view. E. tip of front tibia. F. tip of middle tibia. G. tip of hind tibia. H. spermathecae. I. cercus.

Plate 9. Pupa. A. dorsal view of abdominal tergites. B. enlarged views of spinose areas. C. terminal segment, left half.

Plate 10. Pupa. A. abdominal sternites. B. thoracic respiratory organ and associated setae. C. spines on abdominal sternites IV to VIII. D. terminal segment, ventral view.

(3) *Synorthocladus tamiapavulus*, sp. nov.

Plate 11. Adult. A. wing, male and female. B. head, male. C. tip of male antenna. D. head, female. E. female antenna. F. abdominal tergites of male showing bases of setae. G. tip of front tibia. H. tip of middle tibia. I, J. tip of hind tibia. K. front tarsus I. L. thorax, dorsal view, female. M. cercus. N. spermathecae.

Plate 12. Adult male. A. hypopygium, dorsal view. B. hypopygium, ventral view. C. anal point and tip of ninth tergite. D. inner lobe of gonocoxite, ventral view. E. inner

lobe of gonocoxite and gonostylus, dorsal view. F. thorax, lateral view. G. tip of front tibia. H. tip of middle tibia. I, J. tip of hind tibia. K. front tarsus V.

Plate 13. Pupa. A. abdominal segments, lateral view. B. terminal segment, ventral view. C. parts of spinose areas, enlarged view.

(4) *Cricotopus bicinctus* (Meigen, 1818)

Figures of male, female, pupa and adult in Sasa (1979, Plates 56–59)

(5) *Cricotopus sylvestris* (Fabricius, 1794)

Figures of male, female, pupa and larva in Sasa (1979, Plates 60–63).

(6) *Cricotopus tricinctus* (Meigen, 1818)

Plate 14. Male. A. wing. B. hind tarsus V. C. middle tarsus V. D. inner margin of gonocoxite, and ventral view of inner lobe. E. hypopygium, left half, dorsal view. G. tip of front tibia. H. tip of middle tibia. I, J. tip of hind tibia.

Plate 15. Male. A. thorax, lateral view. B. head, front view. C. tip of antenna. D. palp. E. coloration of legs. F. abdominal tergites, chaetotaxy and coloration.

Plate 16. Pupa. A. thoracic respiratory organ. B. abdomen, lateral view. C. enlarged view of some spines on tergites. D. some spinules and spines on sternites. E. terminal segment.

(7) *Cricotopus triannulatus* (Macquart, 1826)

Plate 17. Male. A. head. B. tip of antenna. C. tip of front tibia. D. tip of middle tibia. E, F. tip of hind tibia. G. hind tarsus V. H. abdominal tergites. I. inner margin of gonocoxite, and gonostylus. J. inner lobe of gonocoxite, ventral view. K. hypopygium, dorsal view.

Plate 18. Pupa. A. thoracic respiratory organs. B. abdomen, lateral view. C. some spines of abdominal tergites. D. spines and spinules on sternite IV. E. terminal segment.

(8) *Cricotopus tamannulatus*, sp. nov.

Plate 19. Adult. A. wing of male and female. B–H: body parts of male. B. thorax, lateral view. C. abdominal tergites II to VI. D. tip of front tibia. E. top of middle tibia. F. tip of hind tibia. G. inner lobe of gonocoxite, ventral view. H. inner margin of gonocoxite, dorsal view of inner lobe, and gonostylus.

Plate 20. Male. A. head. B. tip of antenna. C. hind tarsus V. (plv: pulvillus; clw: claw; emp: empodium). D. hypopygium, dorsal view. E. hypopygium, ventral view.

Plate 21. Female. A. head. B. antenna. C. thorax, dorsal view. D. tip of front tibia. E. tip of middle tibia. F, G. tip of hind tibia. H. abdomen, dorsal view. I. spermathecae. J. cercus.

Plate 22. Pupa. A. thoracic respiratory organ. B. abdomen, lateral view. C. enlarged view of spines and spinules. D. terminal segment.

(9) *Cricotopus metatibialis* Tokunaga, 1936

Plate 23. Male. A. head. B. tip of antenna. C. tip of front tibia. D. tip of middle tibia. E. tip of hind tibia. F. front tarsus V. G. thorax, left half, dorsal view. H. inner margins of gonocoxite. I. hypopygium, dorsolateral view.

Plate 24. Adult. A. wing, male and female. B. female antenna. C. female head. D. dorsal view of thorax, female. E. front tarsus V, female. F. cersus. G. spermathecae.

Plate 25. Adult. A. abdominal tergites, male. B. coloration of legs, male. C. tip of front tibia, female. D. tip of middle tibia, female. E. tip of hind tibia, female. F. abdominal tergites, female.

Plate 26. Pupa. A. thoracic respiratory horn. B. abdominal tergites. C. enlarged view of spines and spinules on some tergites. D. lateral hairs on segment IV, left side. E. anal segments.

(10) *Cricotopus tamasimplex*, sp. nov.

Plate 27. Male. A. wing. B. head. C. tip of antenna. D. thorax, lateral view. E. hind tarsus V, showing claw, empodium, and absence of pulvilli. F. coloration of femora and tibiae. G. tip of front tibia. H. tip of middle tibia. I, J. tip of hind tibia.

Plate 28. Male. A. hypopygium, ventral view. B. hypopygium, dorsal view. C. inner surface of gonocoxite, and gonostylus. D. abdominal tergites.

(11) *Paratrachocladius tamaater*, sp. nov.

Plate 29. Male (excepting for a wing) A. head. B. tip of male antenna. C. thorax, lateral view. D. wing, male and female. E. tip of front tibia. F. tip of middle tibia. G, H. tip of hind tibia.

Plate 30. Male. A. abdominal segments I to VII, lateral view. B. hypopygium, dorsal view. C. inner lobe of gonocoxite, dorsal view. D. inner lobe of gonocoxite, ventral view. E. inner margin of gonocoxite, and gonostylus, dorsal view. F. tip of gonostylus, ventral view.

Plate 31. Female. A. palp. B. antenna. C. head. D. thorax, lateral view. E. spermathecae. F. cercus.

Plate 32. Pupa. A. thoracic respiratory organ. B. abdominal segments, lateral view. C. some spines on abdominal tergites. D. spinules and spines on abdominal sternites. E. anal segment.

(12) *Nanocladius tamabicolor*, sp. nov

Plate 33. Adult. A. wing, male and female. B. head, C. antenna, D. thorax and abdomen, dorsal view, E. spermathecae, F. cercus, female.

Plate 34. Male. A. head. B. antenna. C. tip of antenna. D. thorax and abdomen, dorsal view. E. tip of front tibia. F. tip of middle tibia. G. tip of hind tibia. H. hind tarsus V, showing pulvilli, claws and empodium.

Plate 35. Male and pupa. A. hypopygium, dorsal view. B. hypopygium, ventral

view. C. anal point. D. inner margin of gonocoxite, and gonostylus. E. thoracic respiratory organ and associated hairs, pupa.

Plate 36. Pupa. A. abdominal tergites I-VI. B. some hairs and spines on abdominal tergites. C. abdominal segments VII, VIII and IV, dorsal view.

(13) *Parametriocnemus stylatus* (Kieffer, 1924)

Plate 37. Adult. A. head, female. B. head, male. C. palp, female. D. antenna, female. E. tip of antenna, male. F. wing, male and female. G. front tarsus V, female. H. thorax, female. I. thorax, male. J. thorax, male, lateral view. K. cercus, female. L. hind tarsus V. M. tip of front tibia, female, showing absence of terminal spur. N. tip of middle tibia. O, P. tip of hind tibia.

Plate 38. Male. A. hypopygium, dorsal view. B. hypopygium, ventral view. C. inner margin of gonocoxite, and gonostylus. D. anal point. E. tip of front tibia. F. tip of middle tibia. G, H. tip of hind tibia. I. middle tarsus V.

Plate 39. Adult. A. contour of front (f), middle (m) and hind (h) legs, male. B. abdominal tergites II-IX, dorsal view, showing bases of setae, male. C. abdominal tergites, female. D. spermathecae.

Plate 40. Pupa. A. abdominal tergites. B. abdominal sternites. C. some spines on abdominal tergites, arrows showing the midline.

Plate 41. Pupa (A-C) and larva (D-H). A. thoracic respiratory organ. B. anal segments of female pupa. C. anal segments of male pupa. D. labial plate. E. labrum, epipharynx and premandible. F. mandible. G. antenna. H. maxilla.

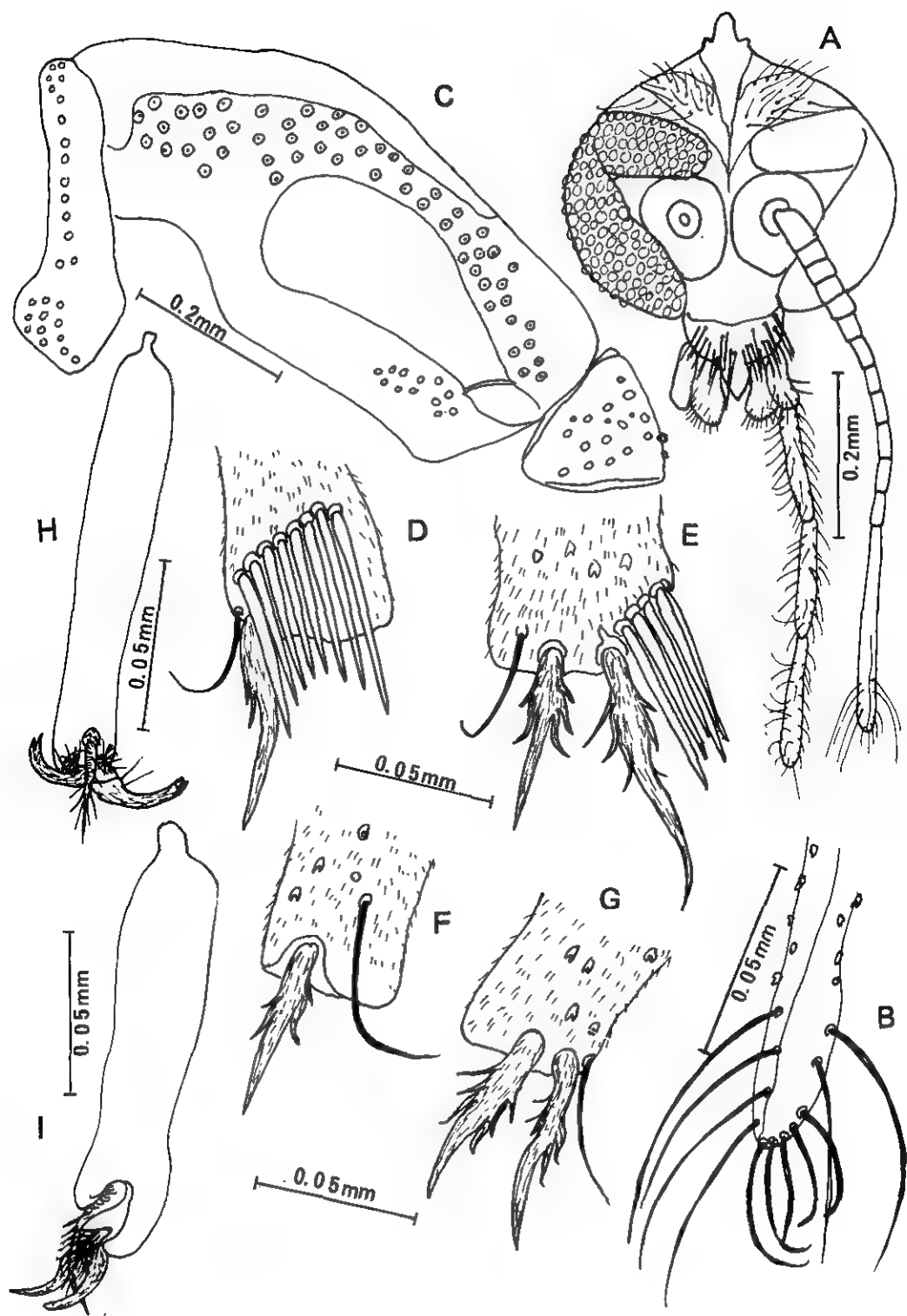
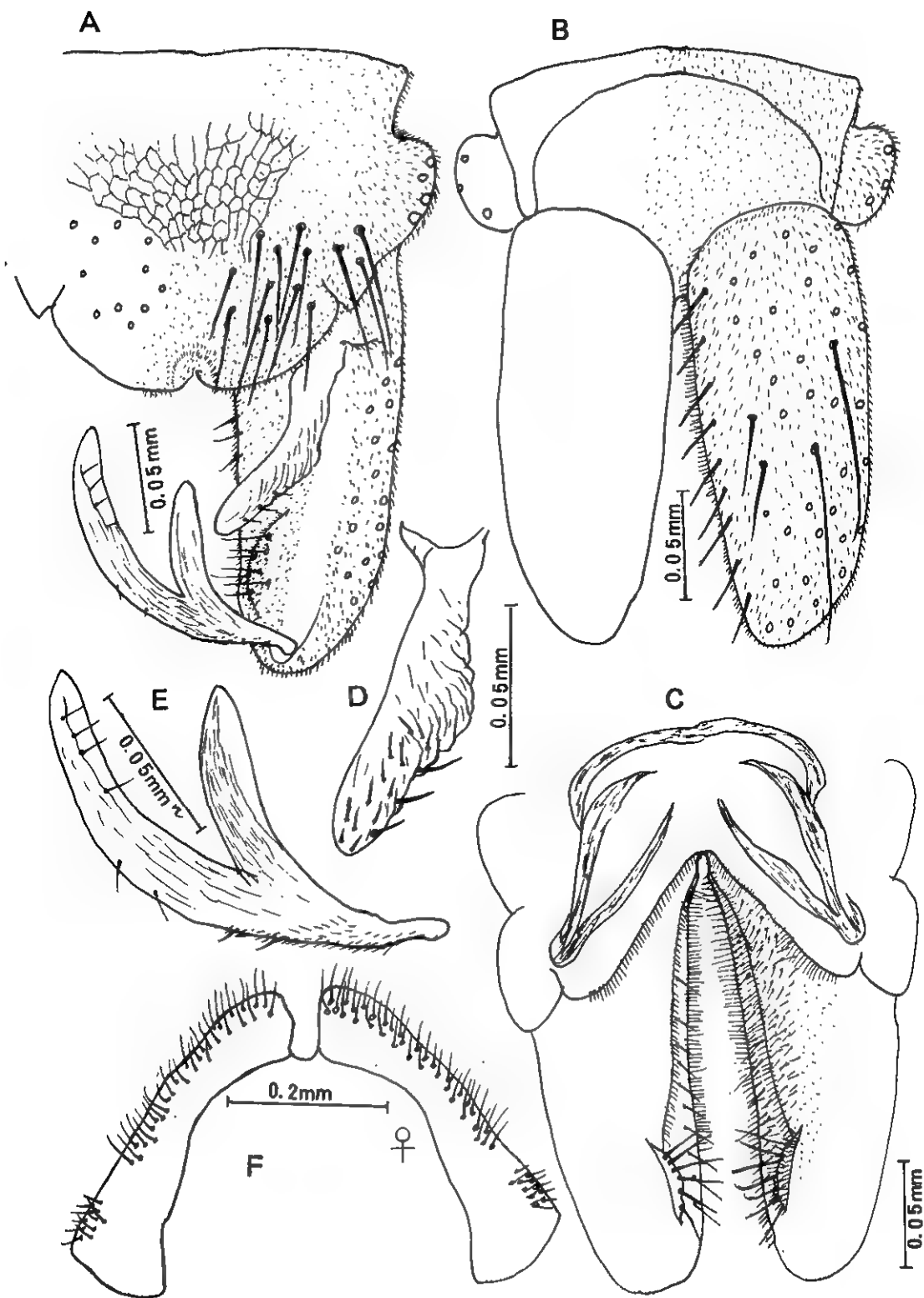


Plate 1. *Brillia japonica* Tokunaga, male



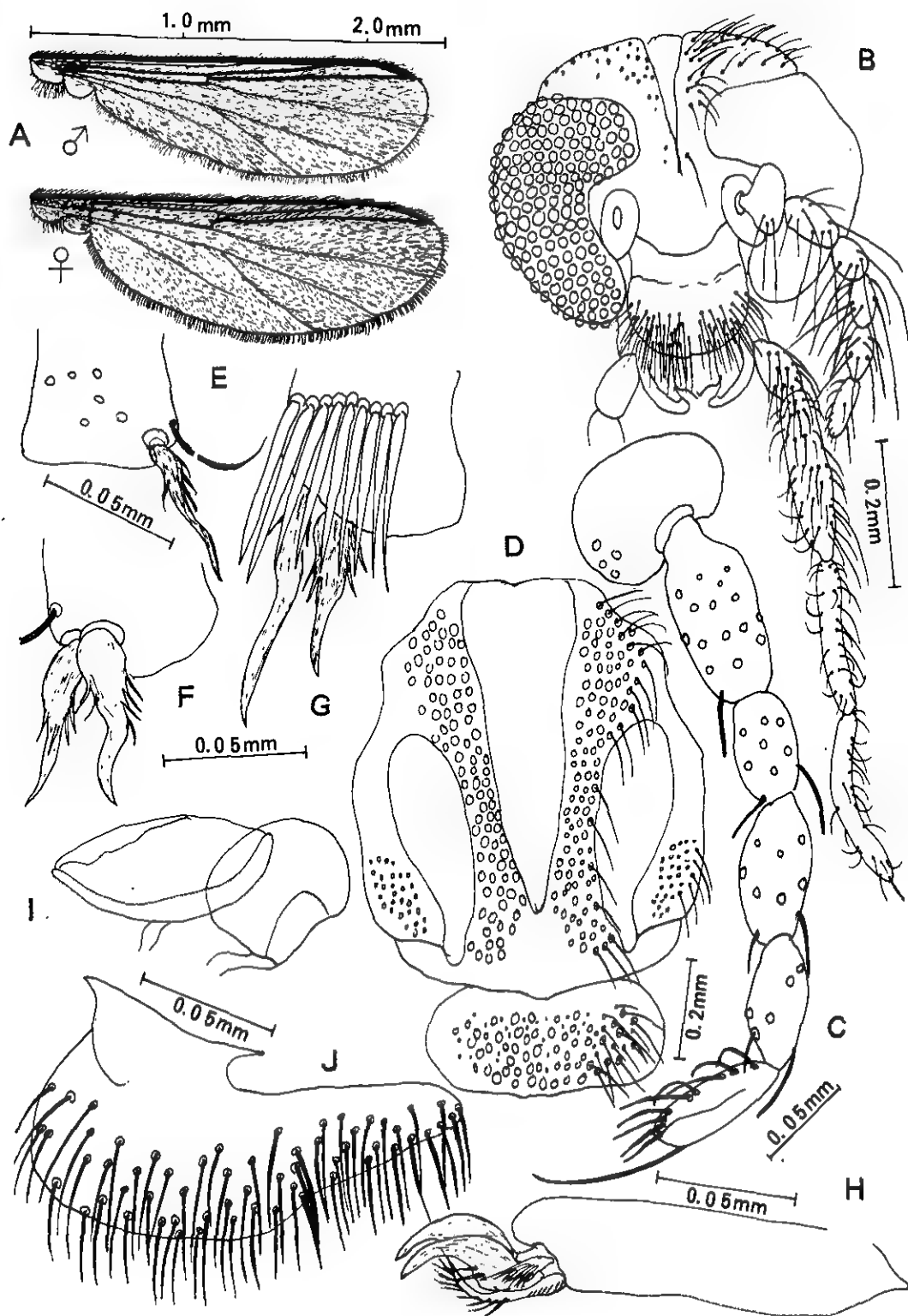


Plate 3. *Brillia japonica* Tokunaga, male and female



Plate 5. *Brillia japonica* Tokunaga, larva (A-H) and pupa (I)

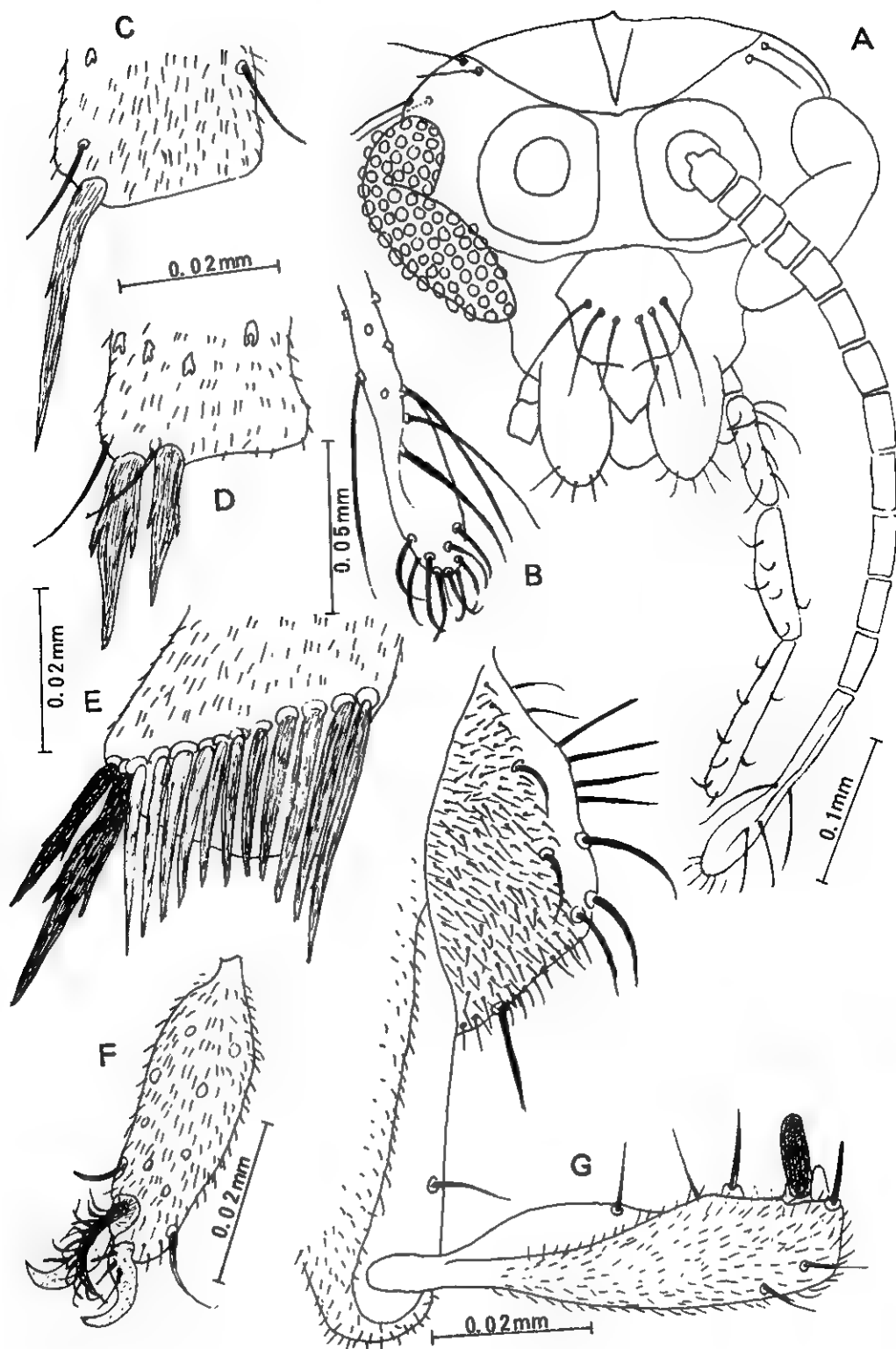


Plate 6. *Eukiefferiella tamaflavus*, sp. nov., male

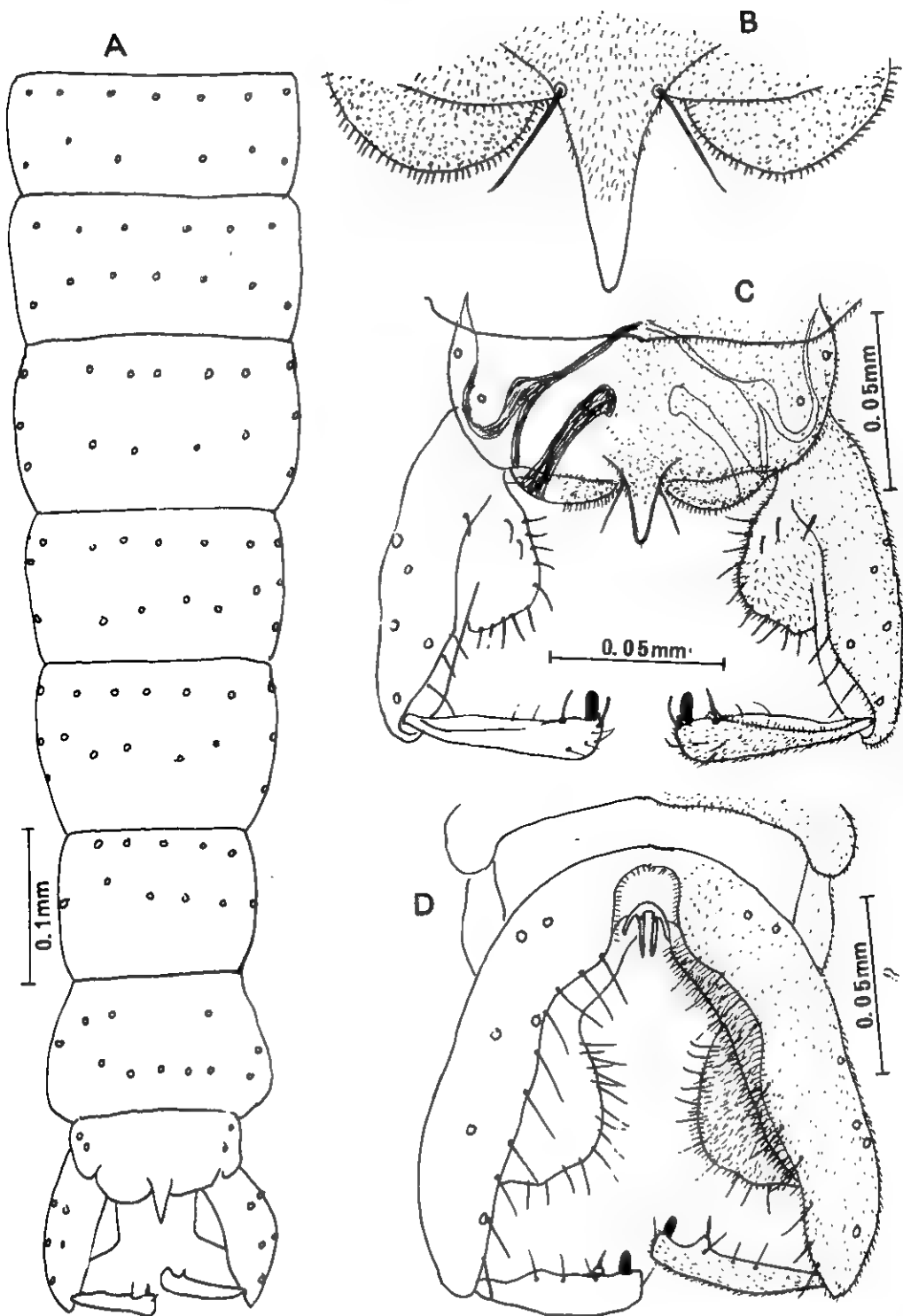


Plate 7. *Eukiefferiella tamaflavus*, sp. nov., male

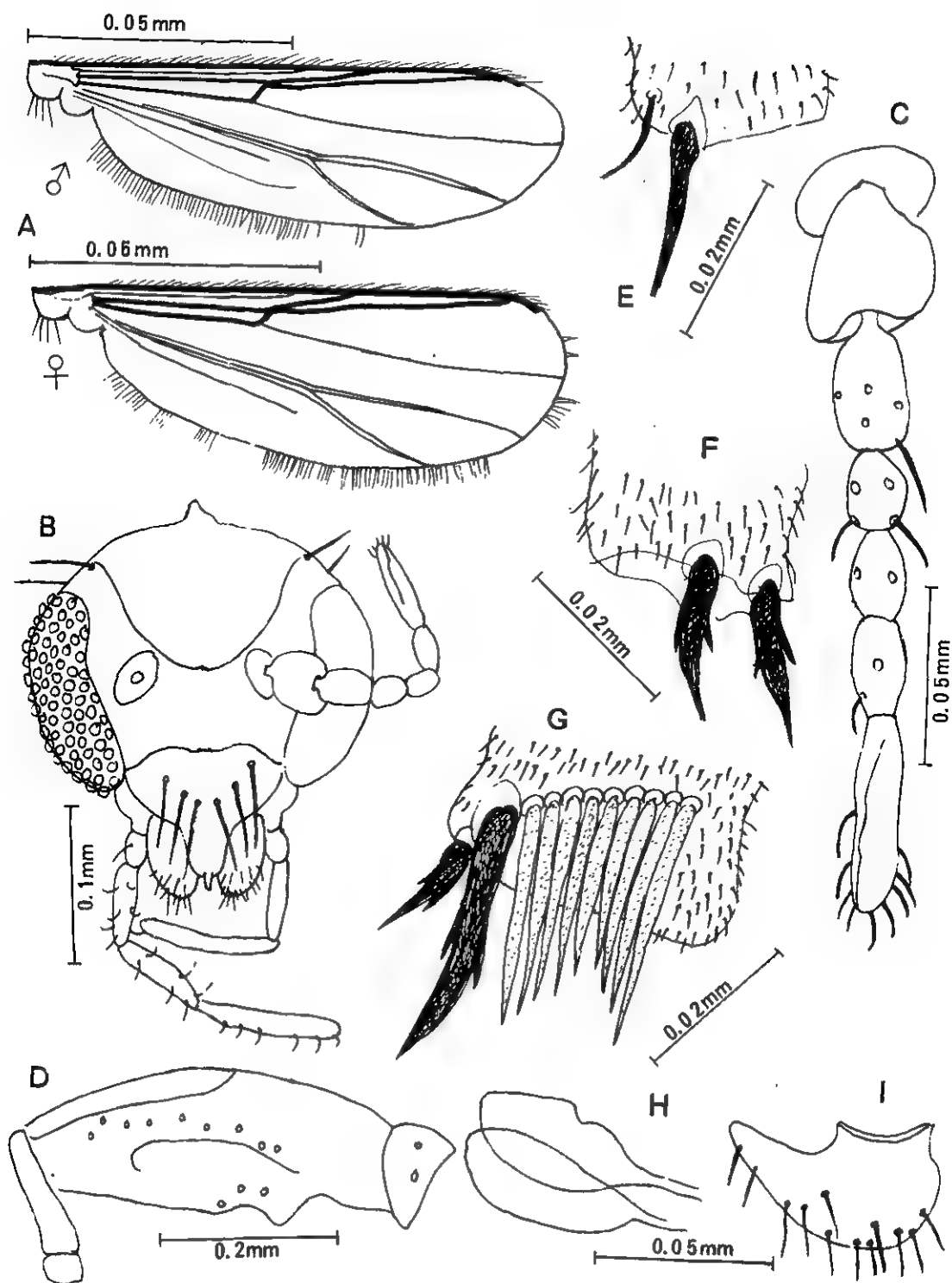


Plate 8. *Eukiefferiella tamaflavus*, sp. nov., male and female

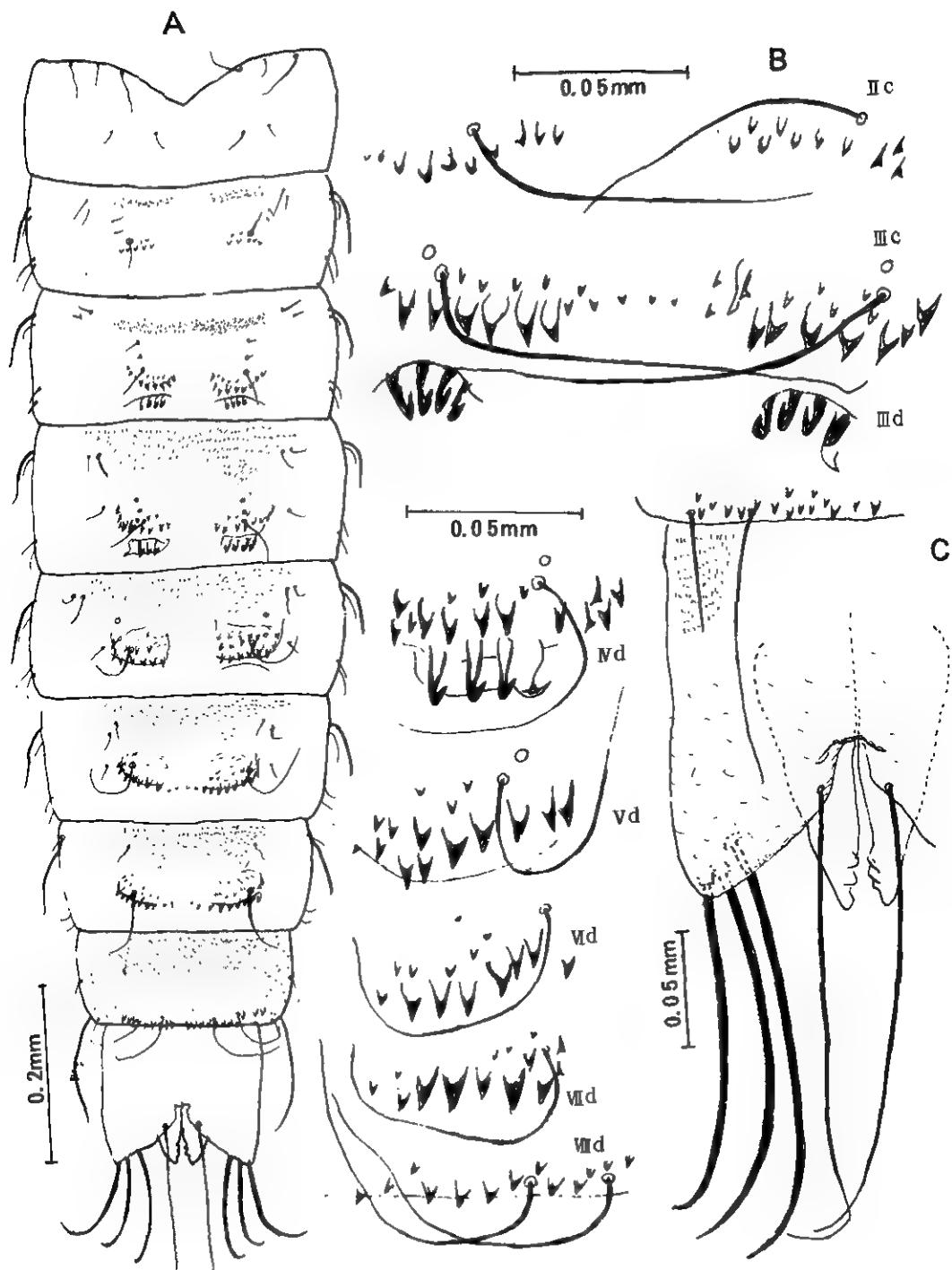


Plate 9. *Eufiefferiella tamaflavus*, sp. nov., pupa

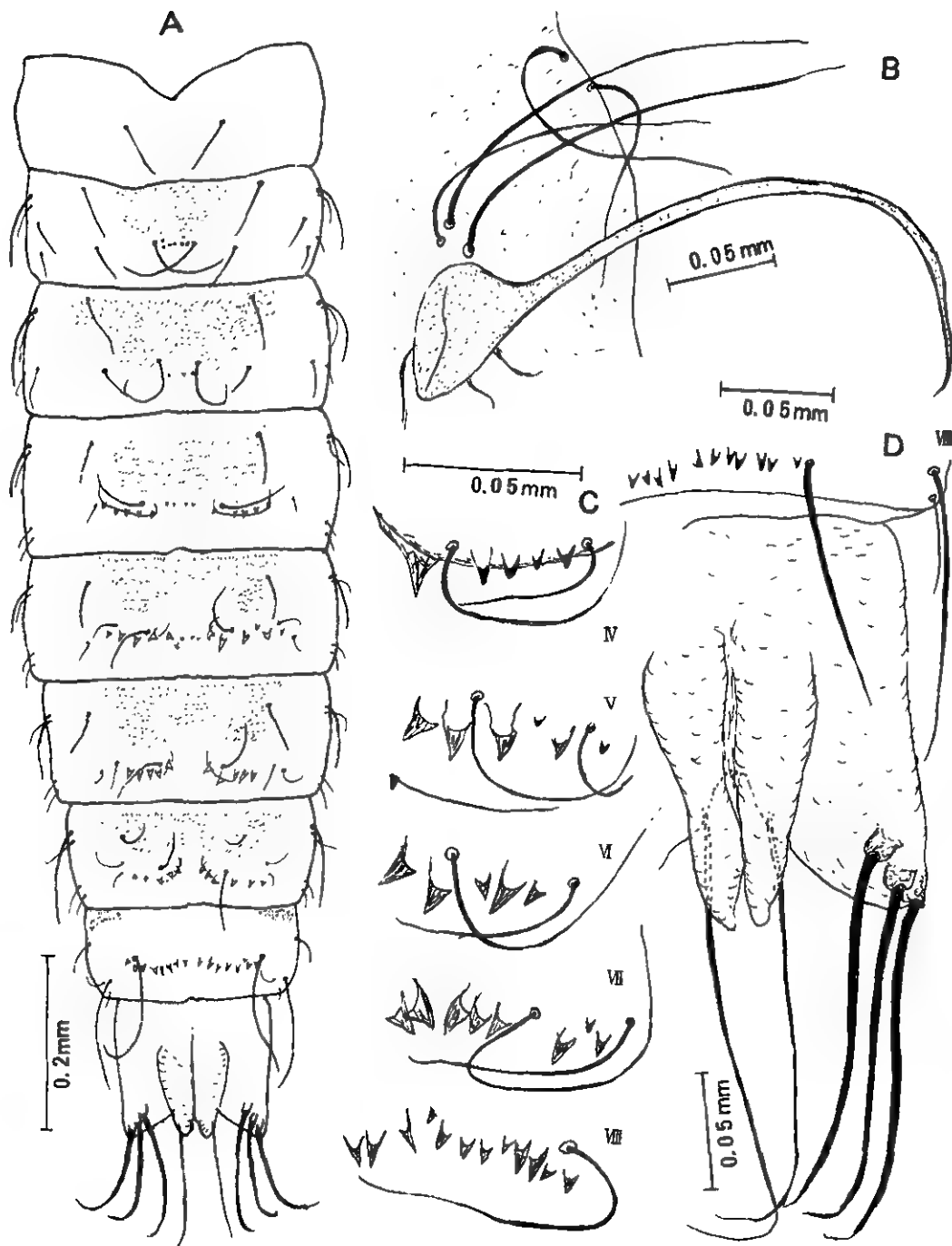


Plate 10. *Eukiefferiella tamaflavus*, sp. nov., pupa

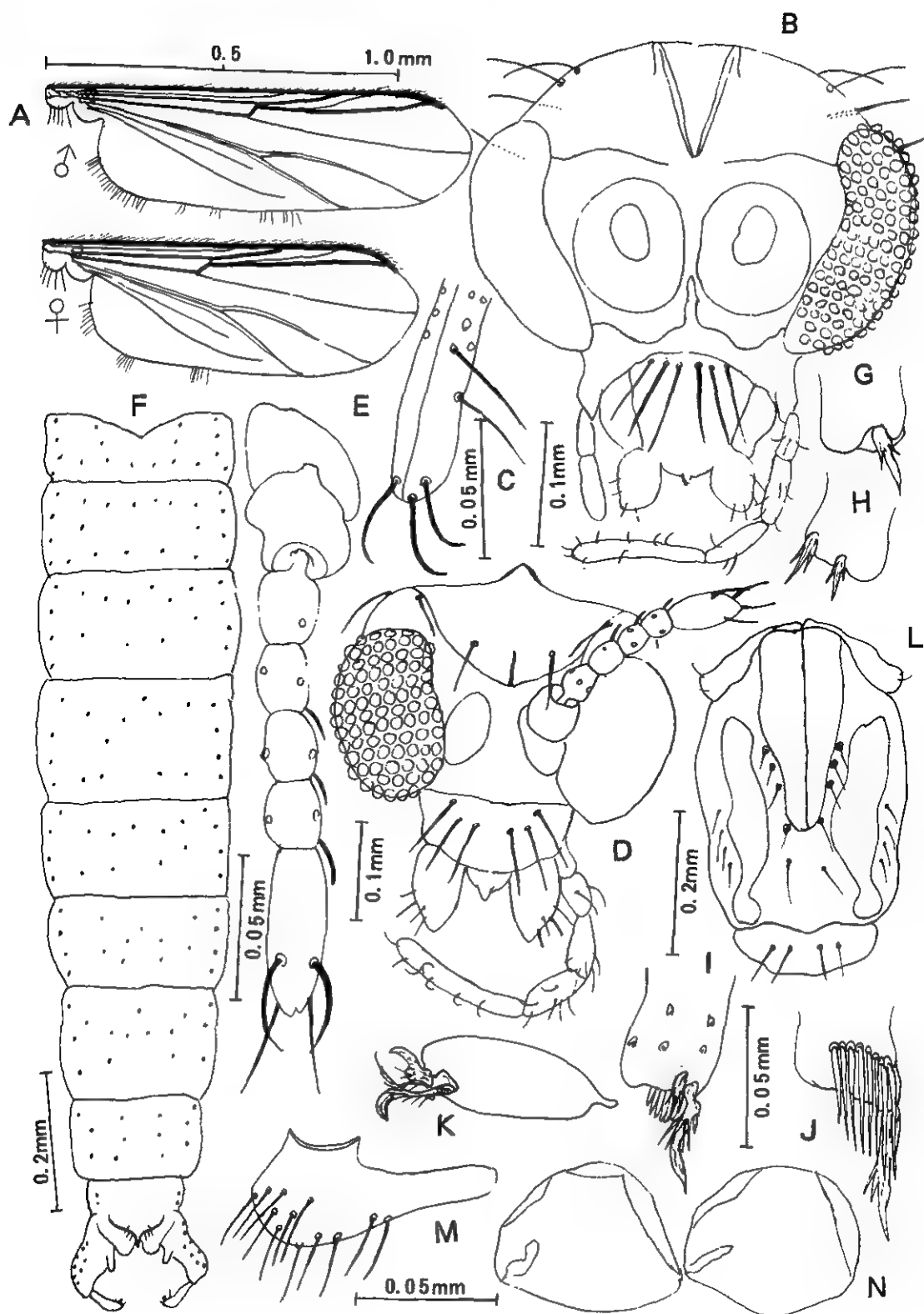
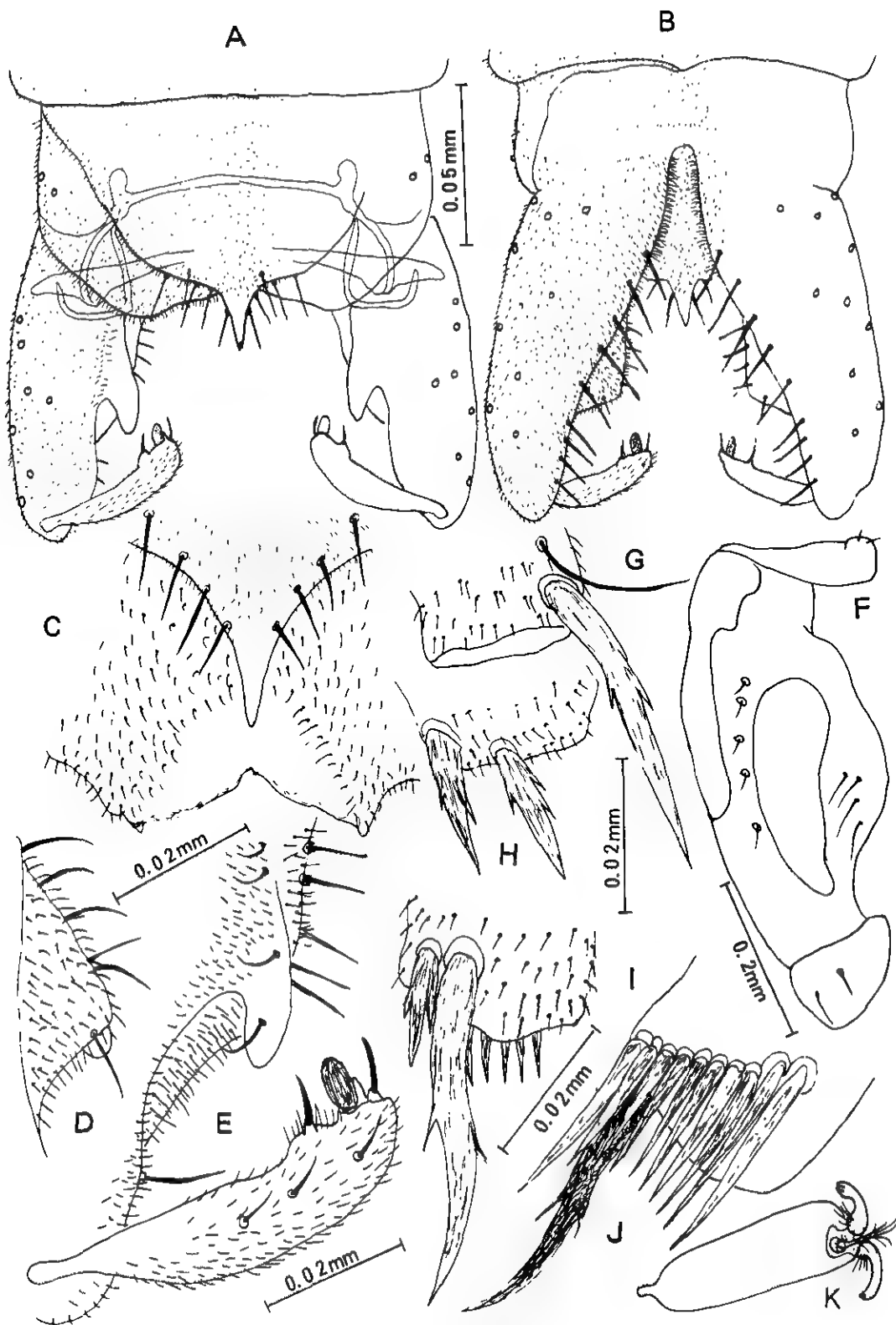


Plate 11. *Synorthocladius tamaparvulus*, sp. nov., male and female



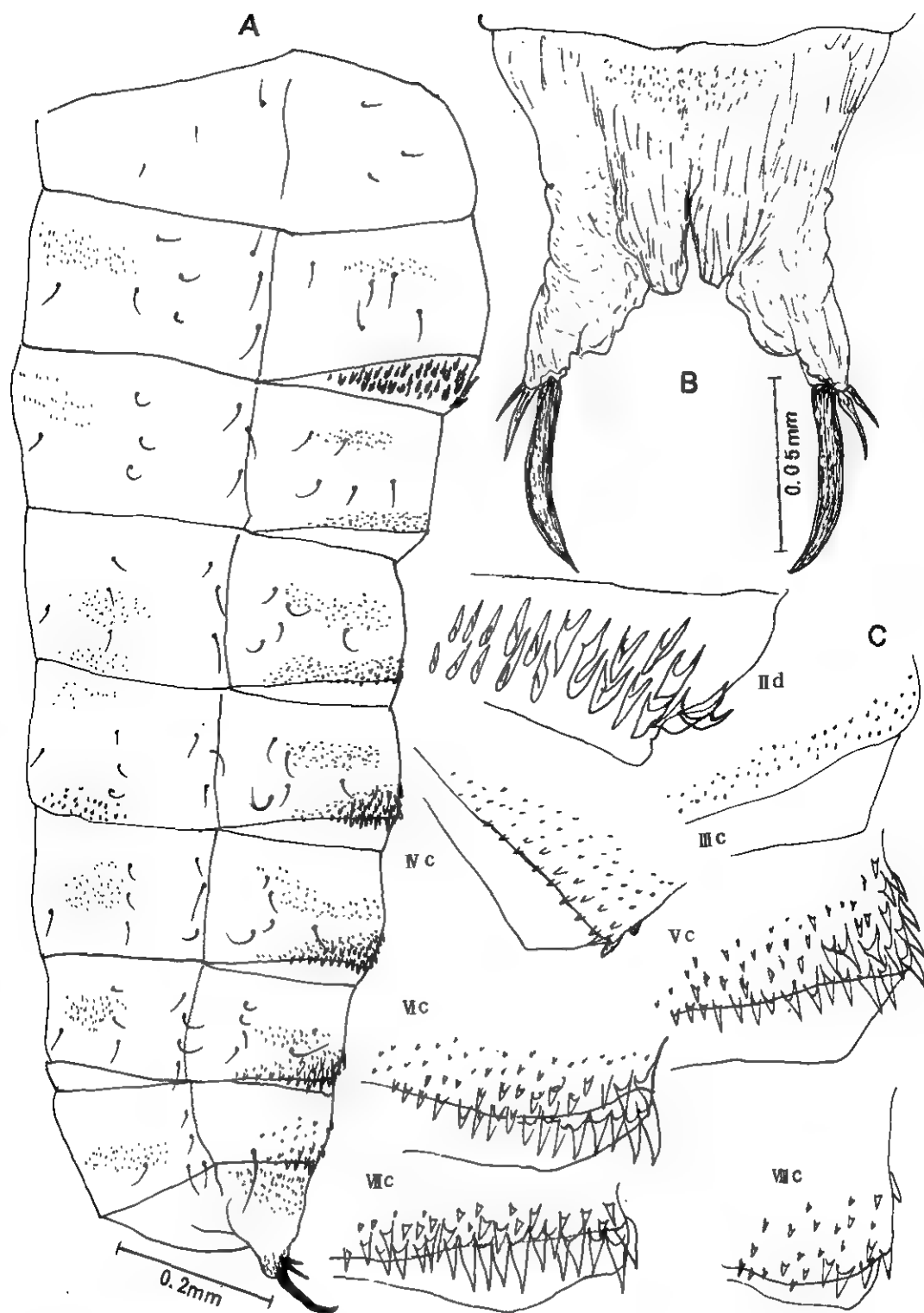


Plate 13. *Synorthocladus tamaparvulus*, sp. nov., pupa

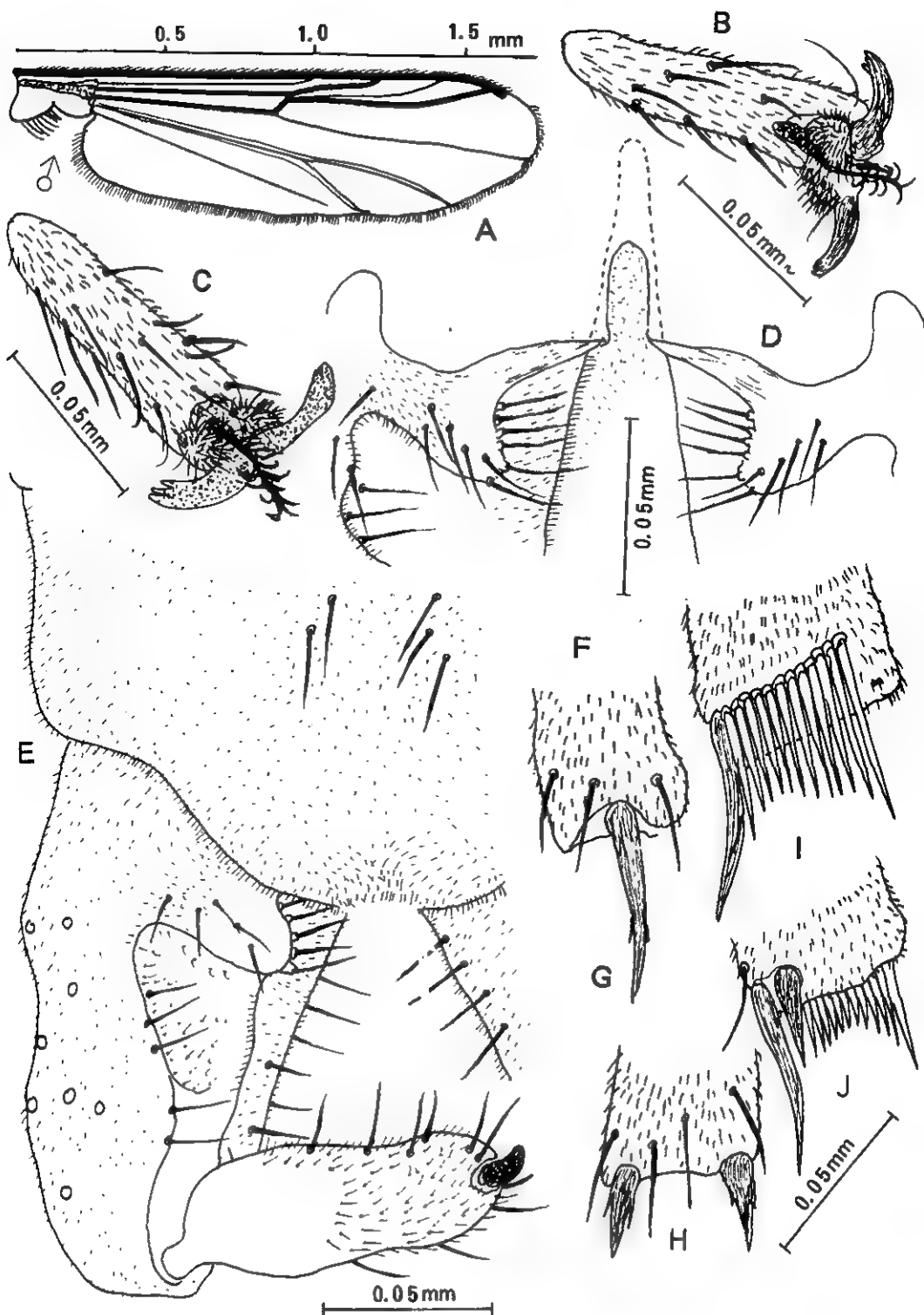


Plate 14. *Cricotopus tricinctus* (meigen), male

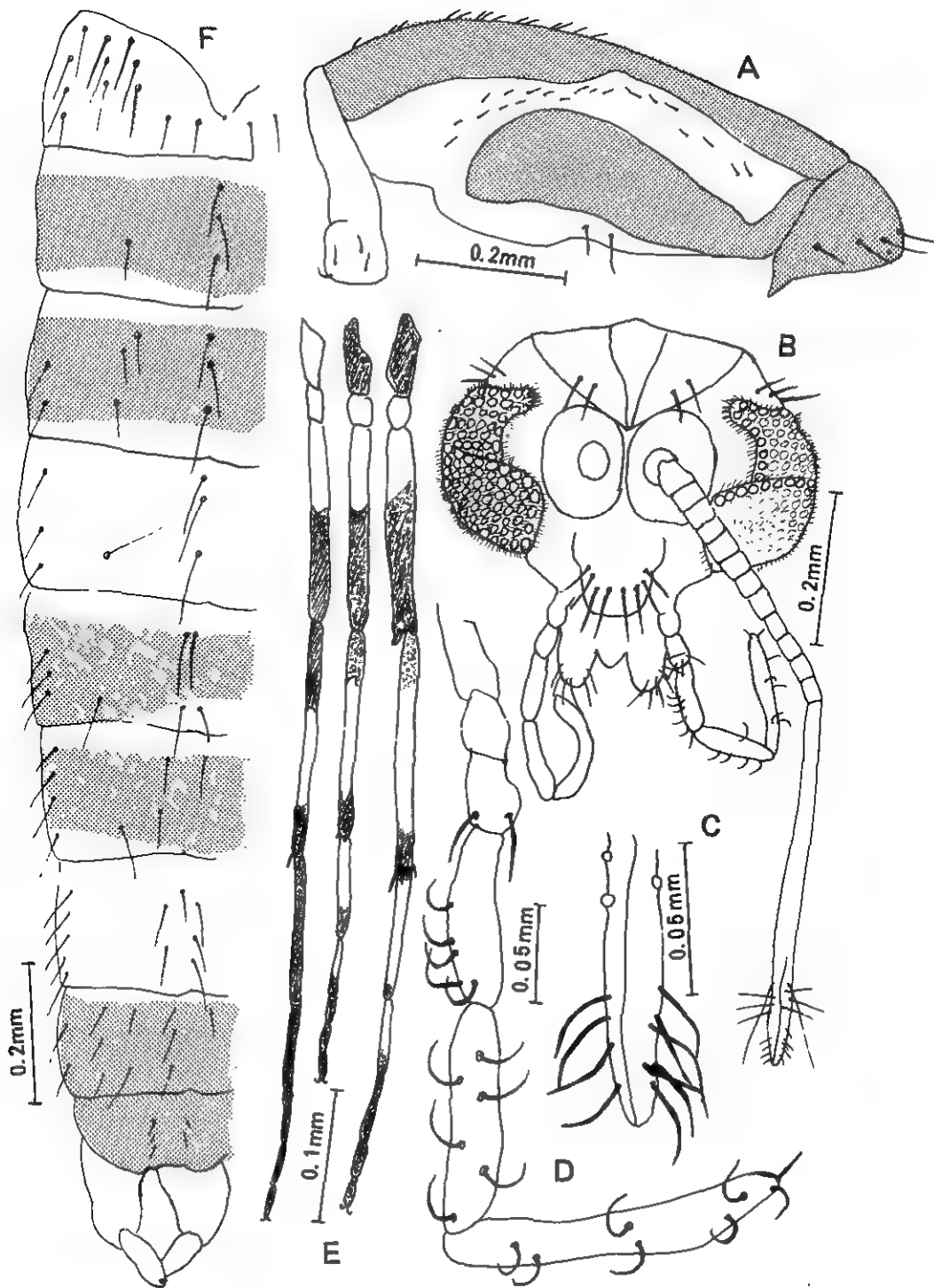


Plate 15. *Cricotopus tricinctus* (Meigen), male

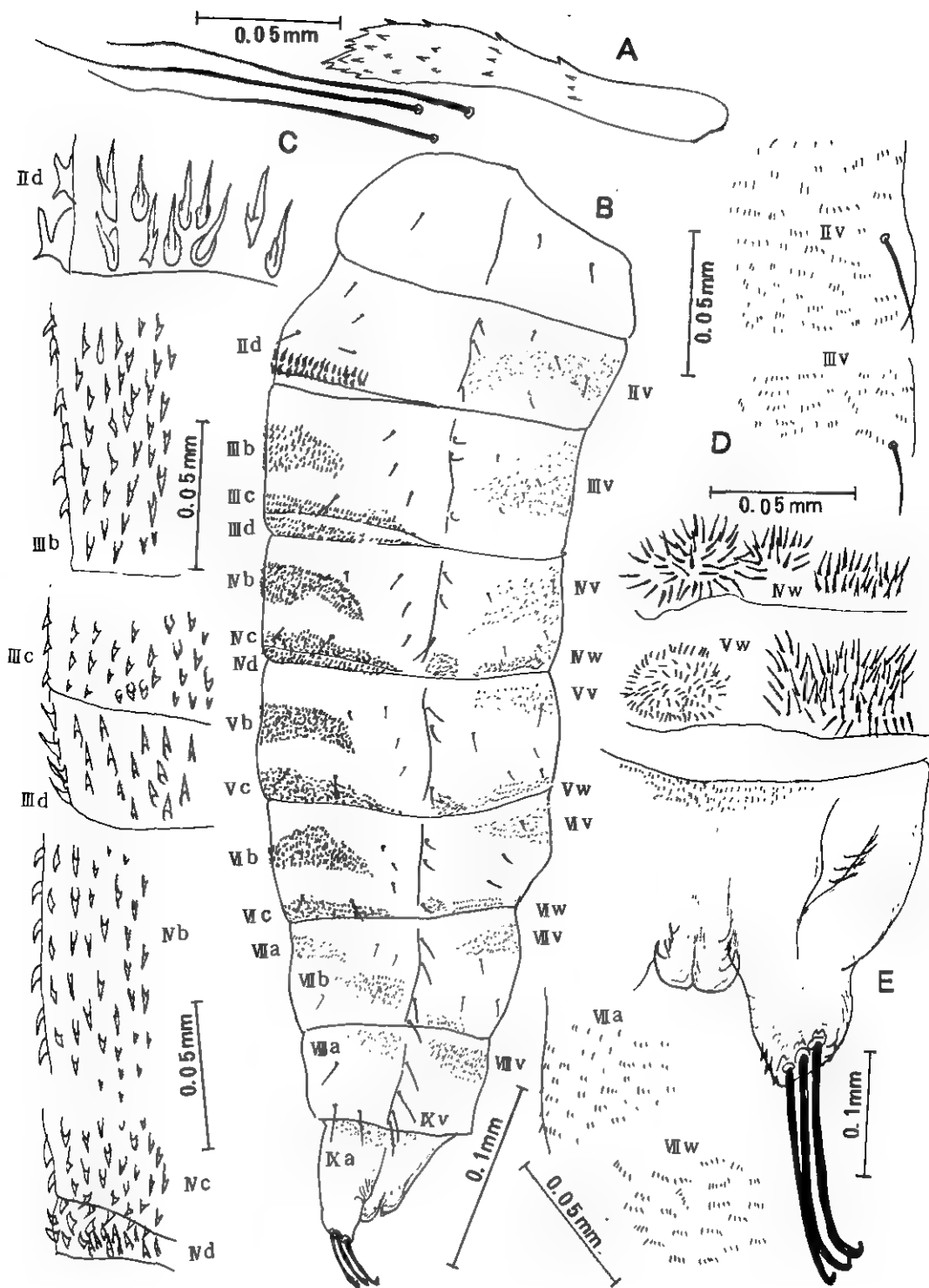


Plate 16. *Cricotopus tricinctus* (Meigen), pupa

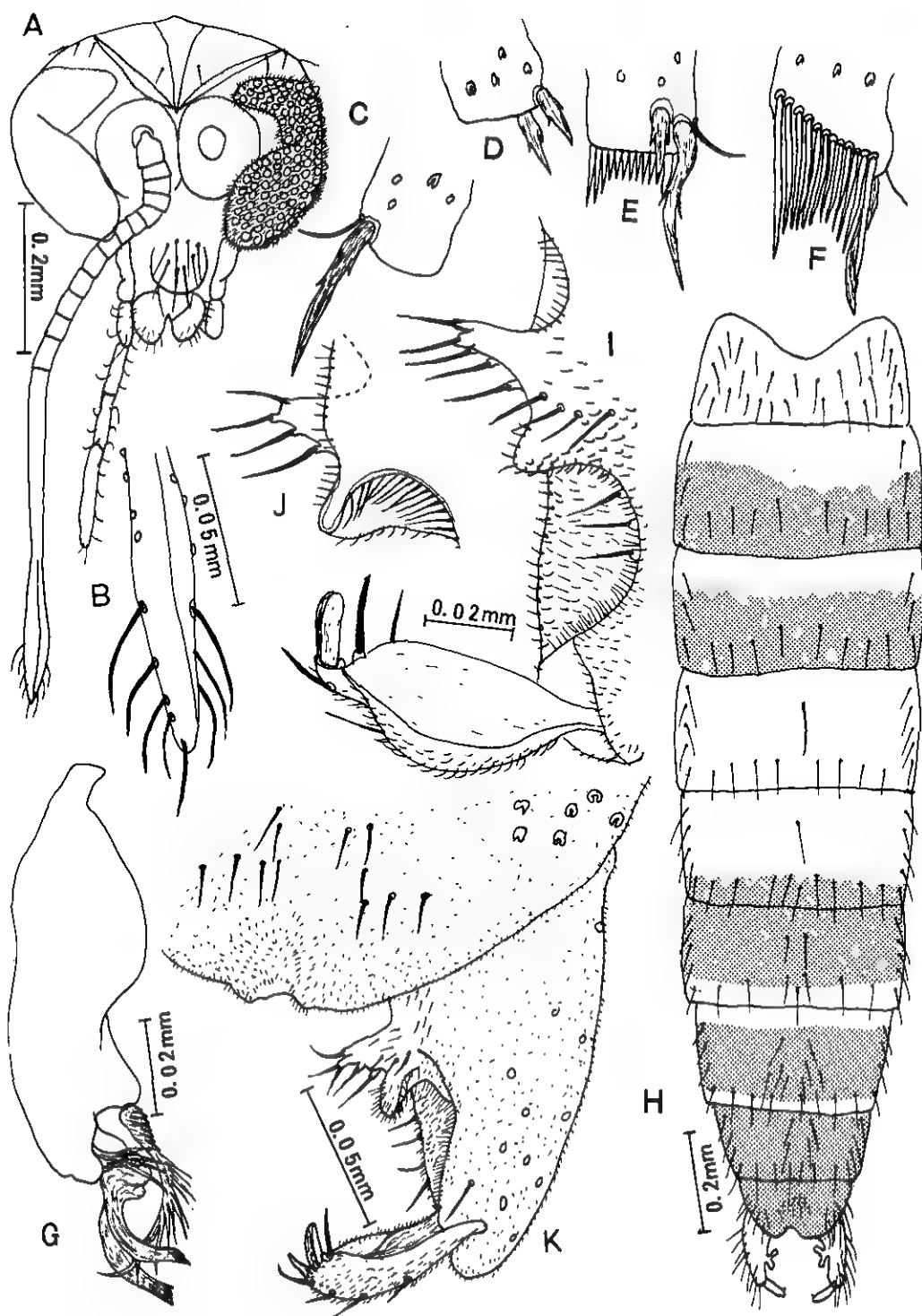


Plate 17. *Cricotopus triannulatus* (Macquart), male

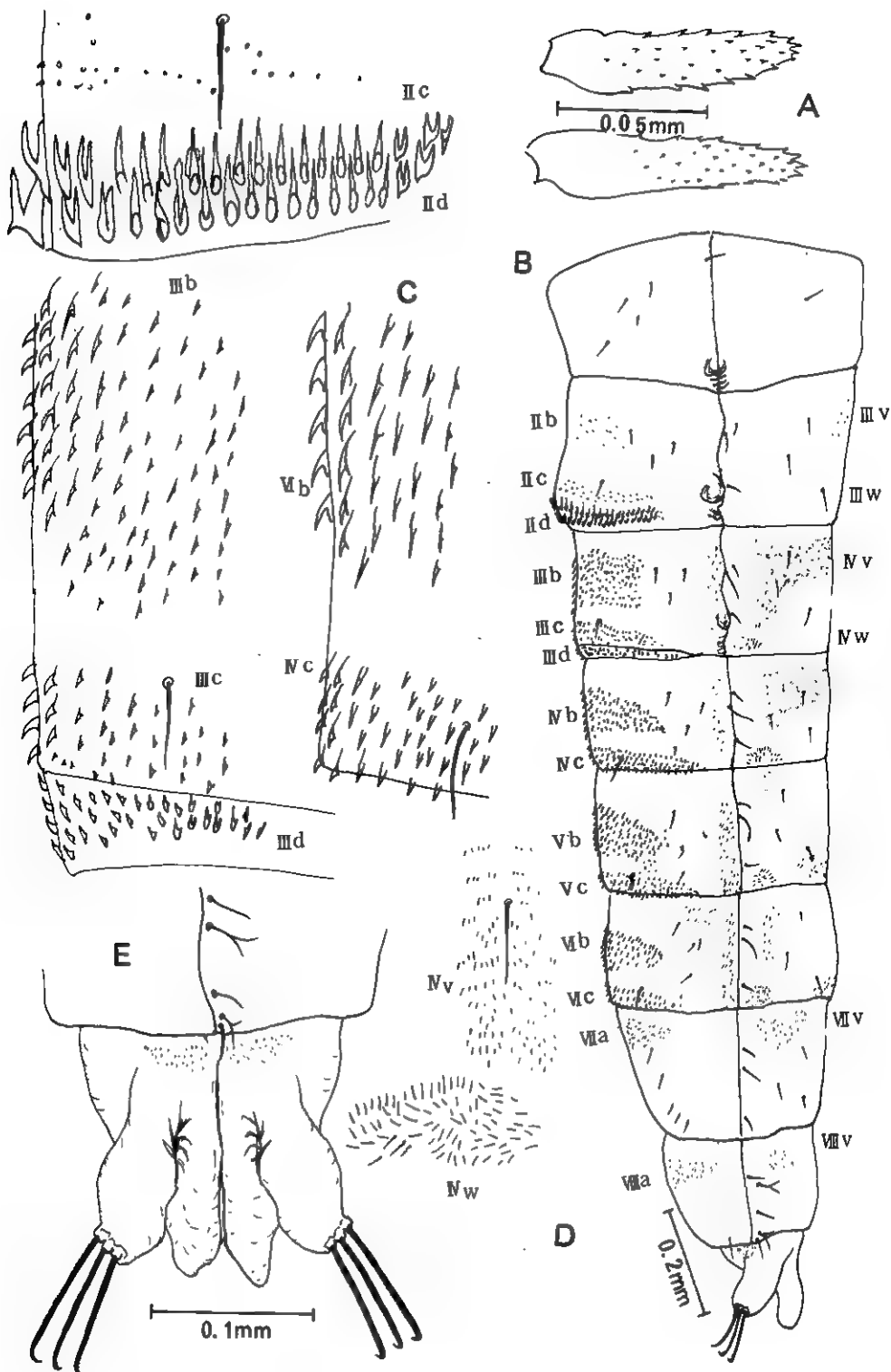


Plate 18. *Cricotopus triannulatus* (Macquart), pupa

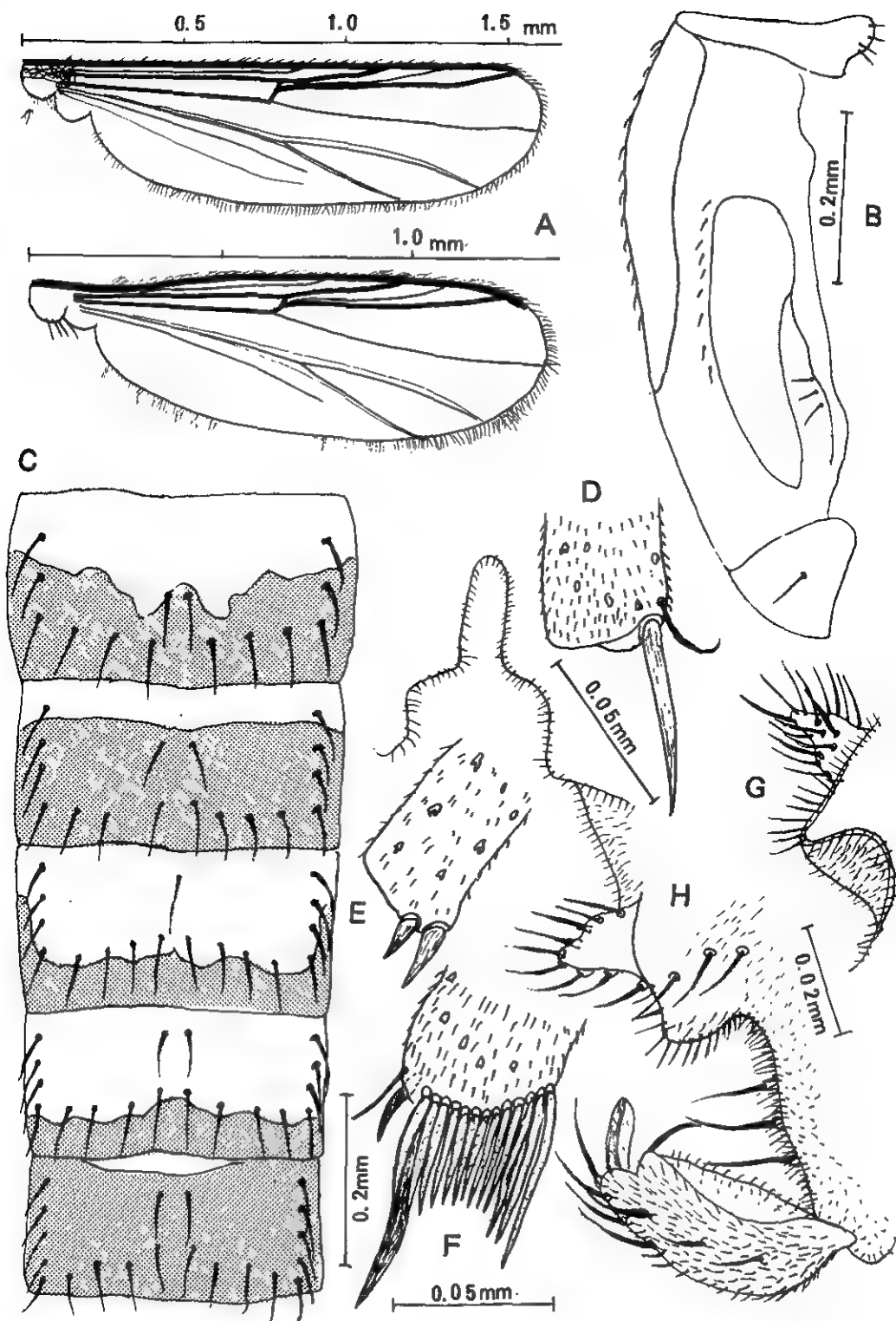


Plate 19. *Cricotopus tamannulatus*, sp. nov., male and female

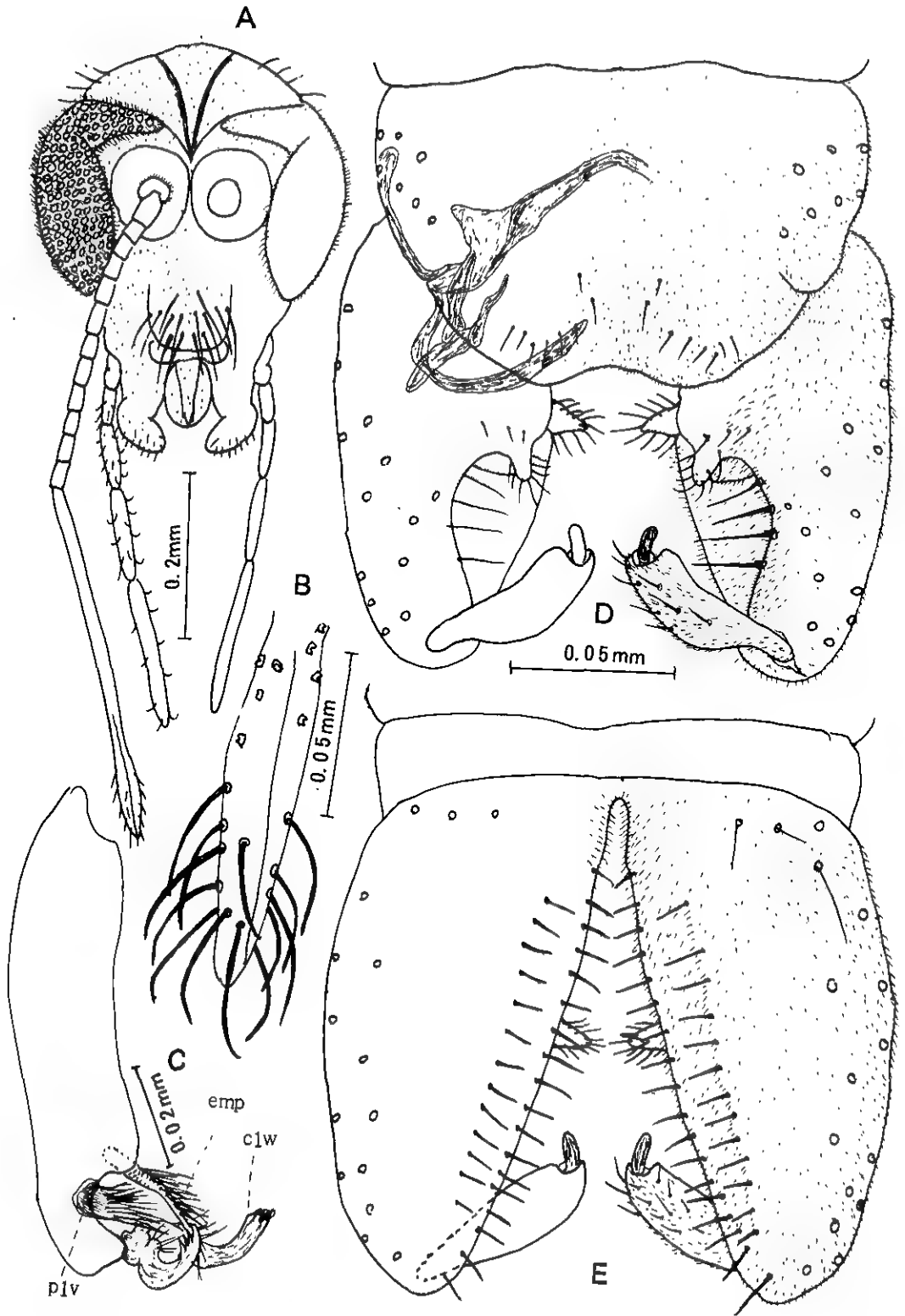


Plate 20. *Cricotopus tamannulatus*, sp. nov., male

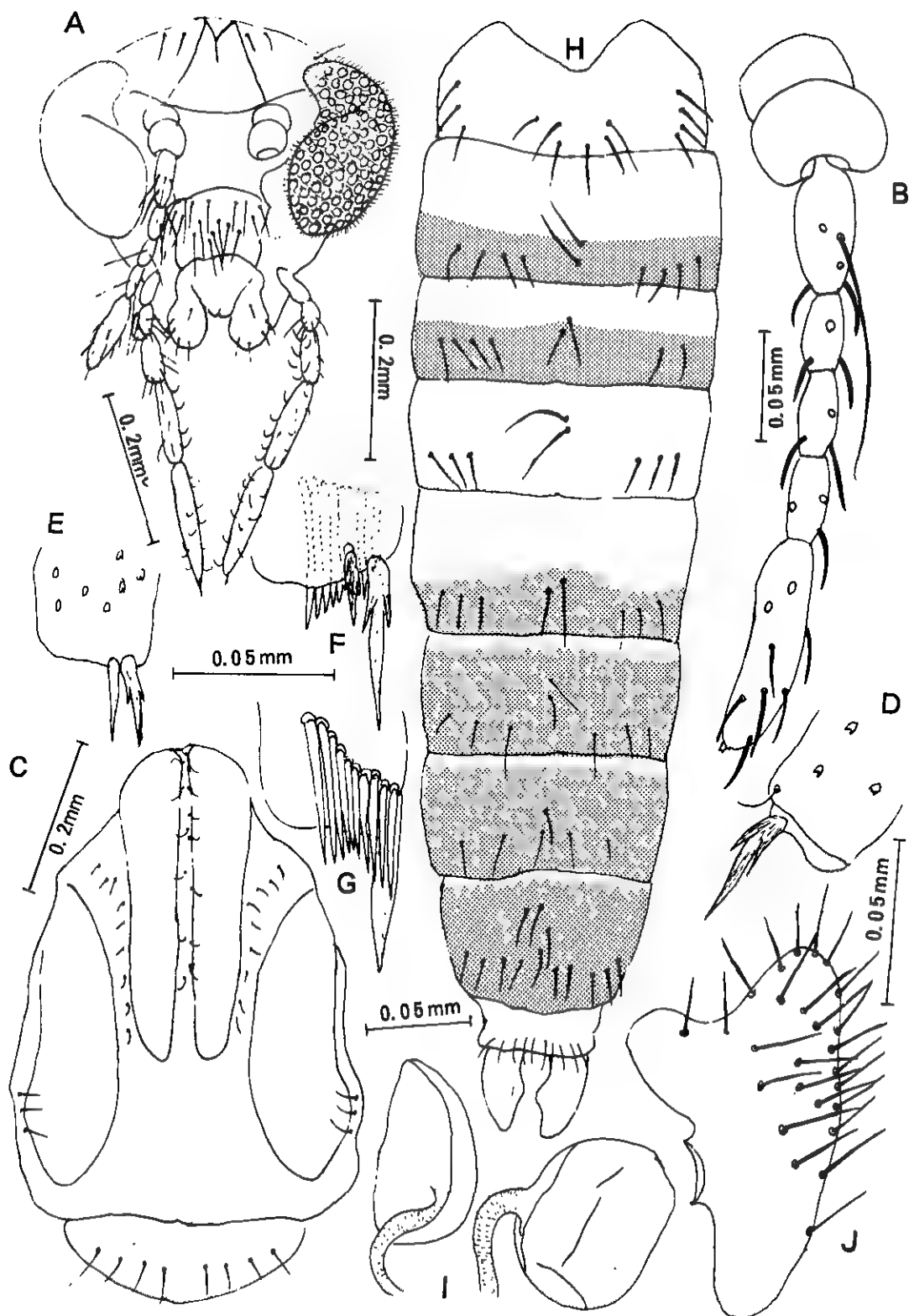


Plate 21. *Cricotopus tamannulatus*, sp. nov., female

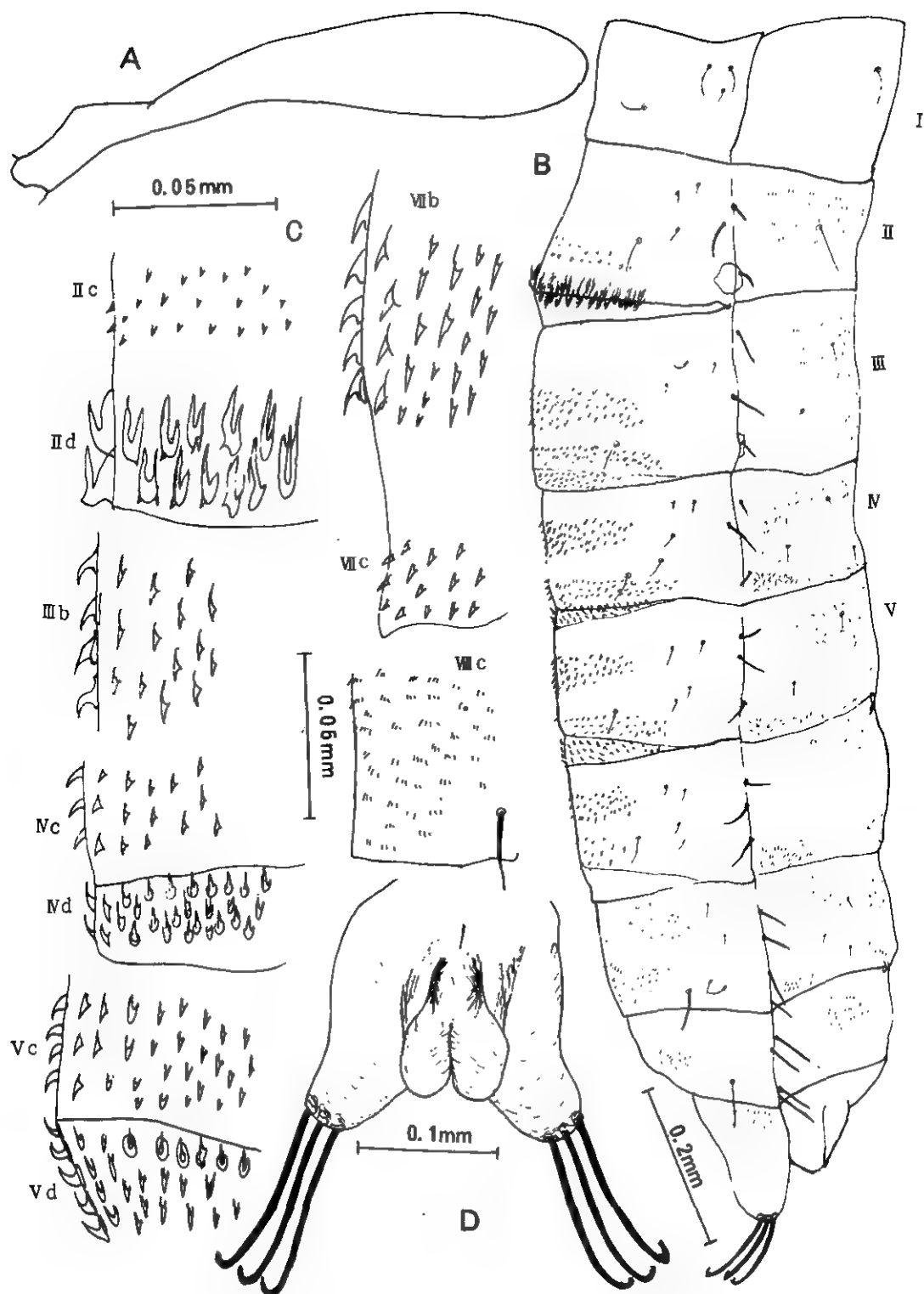


Plate 22. *Cricotopus tamannulatus*, sp. nov., pupa

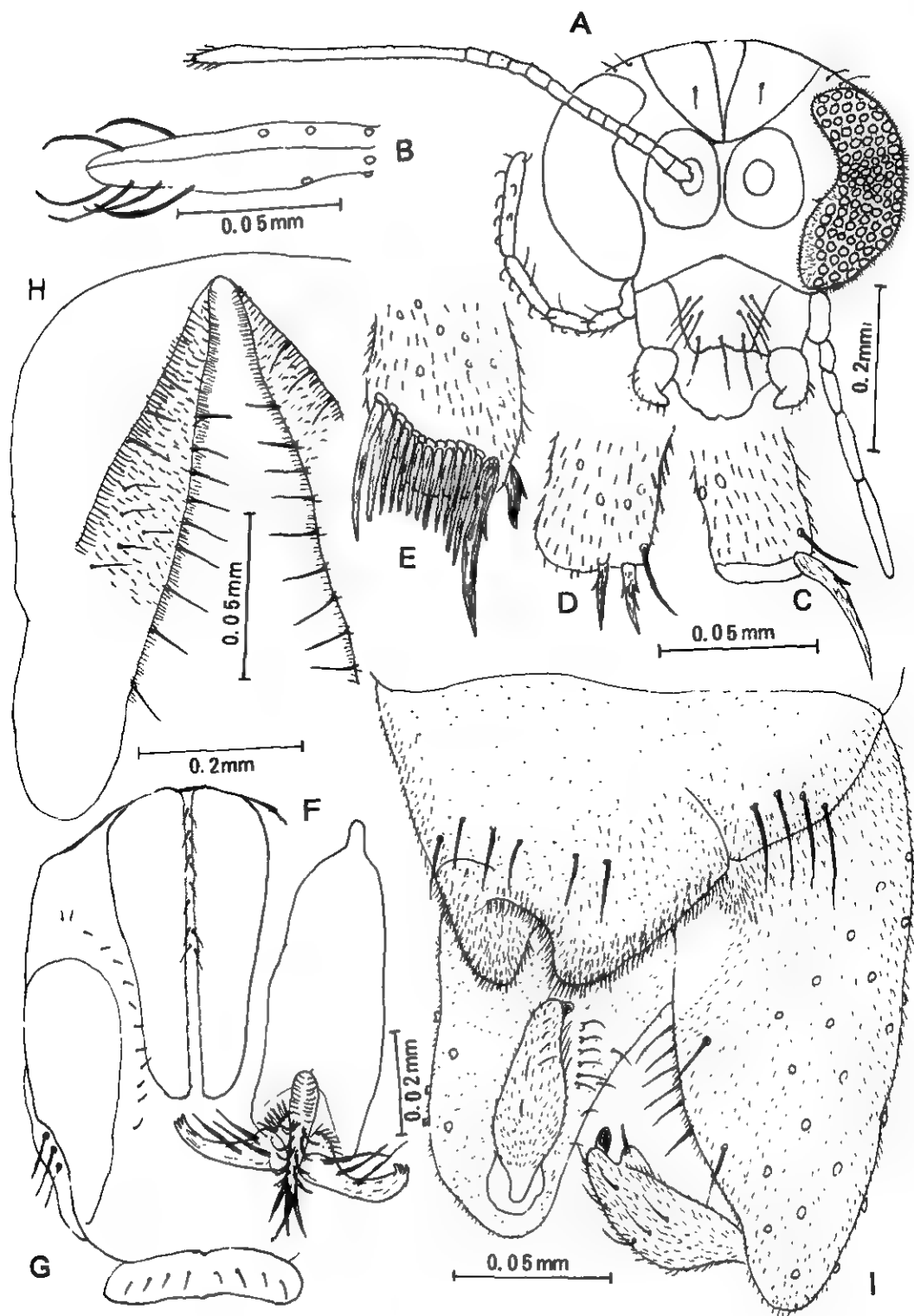


Plate 23. *Cricotopus metatibialis* Tolunaga, male

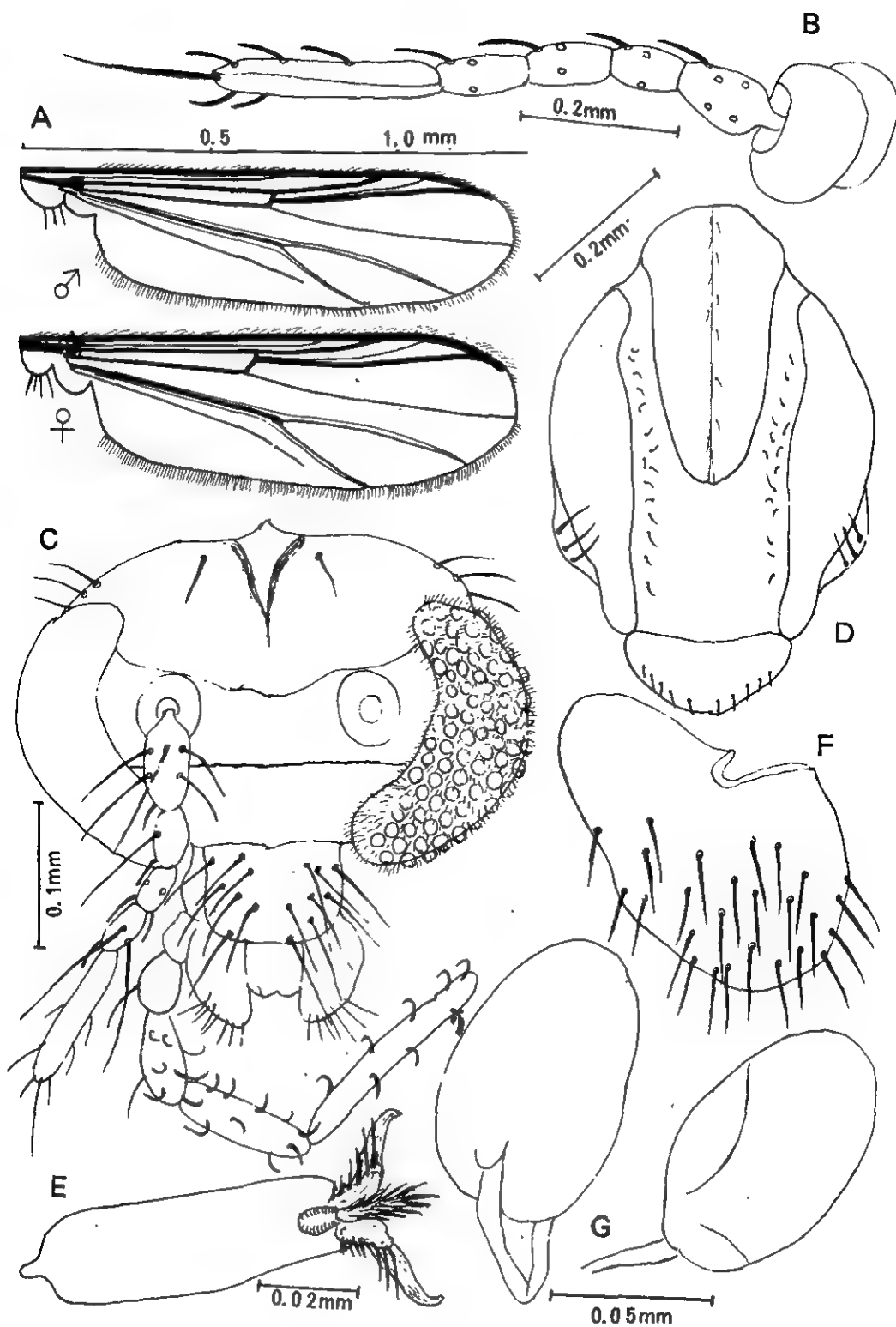


Plate 24. *Cricotopus metatibialis* Tokunaga, male and female

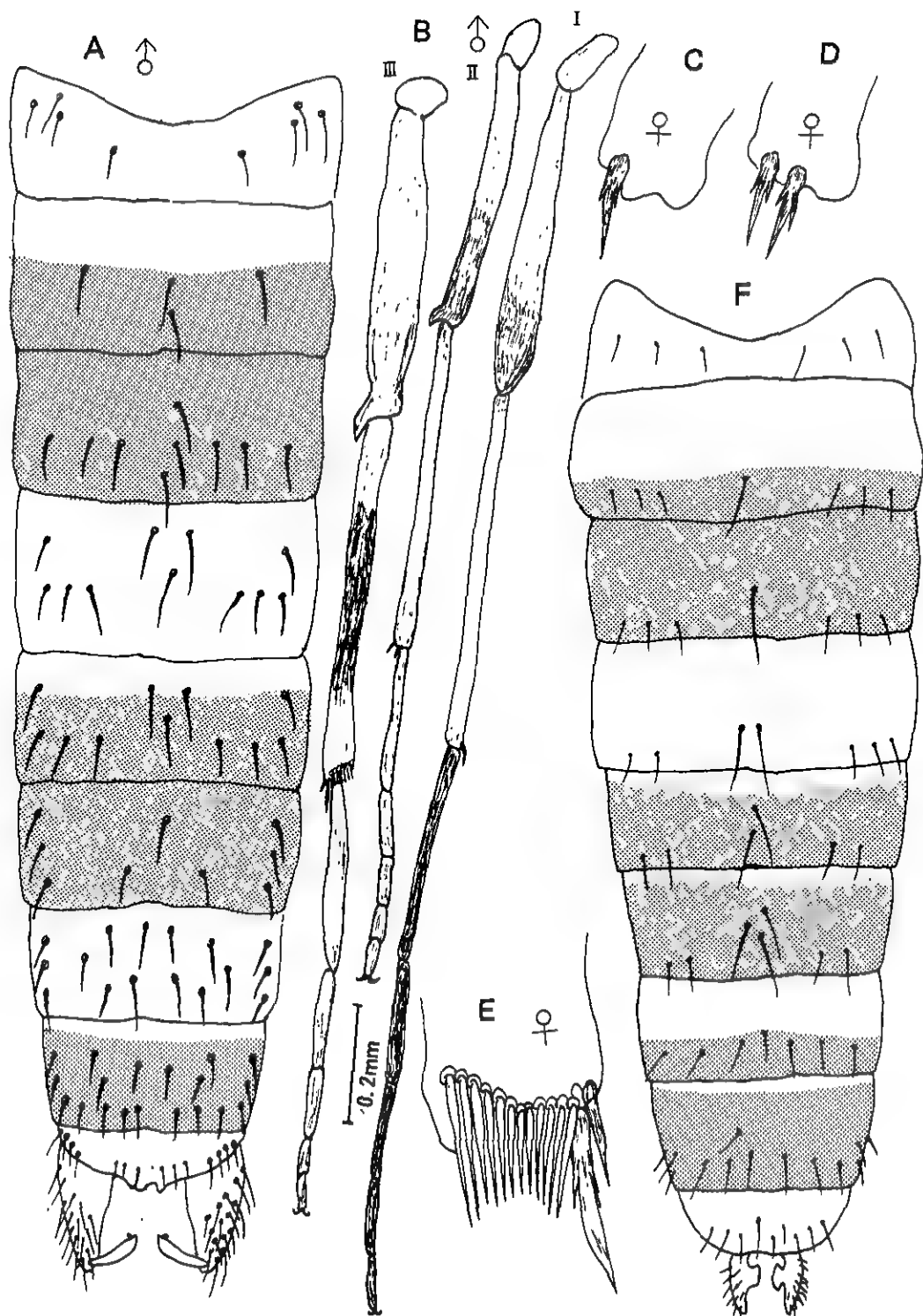


Plate 25. *Crocotopus metatibialis* Tolunaga, male and female

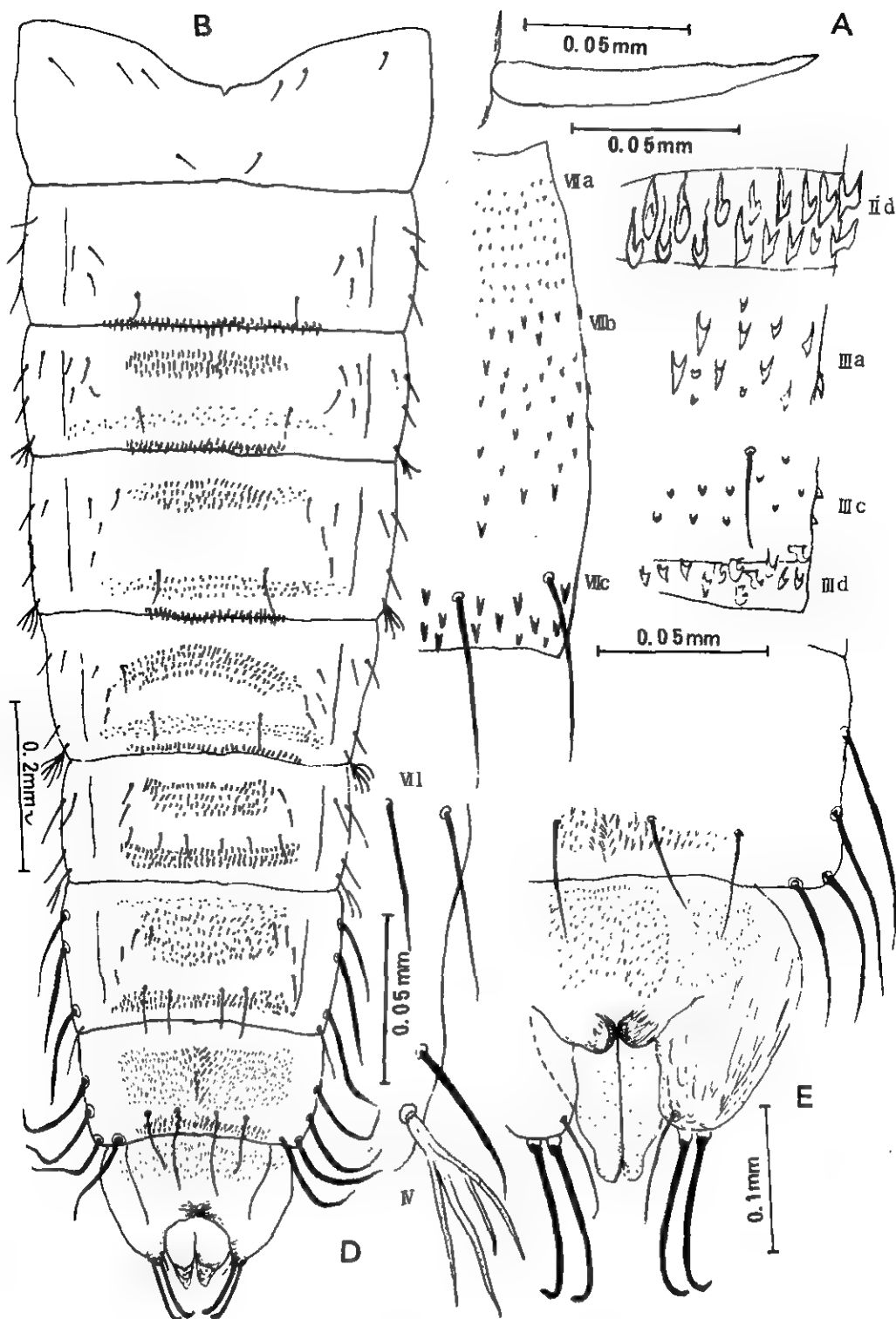


Plate 26. *Crocotopus metatibialis* Tokunaga, pupa

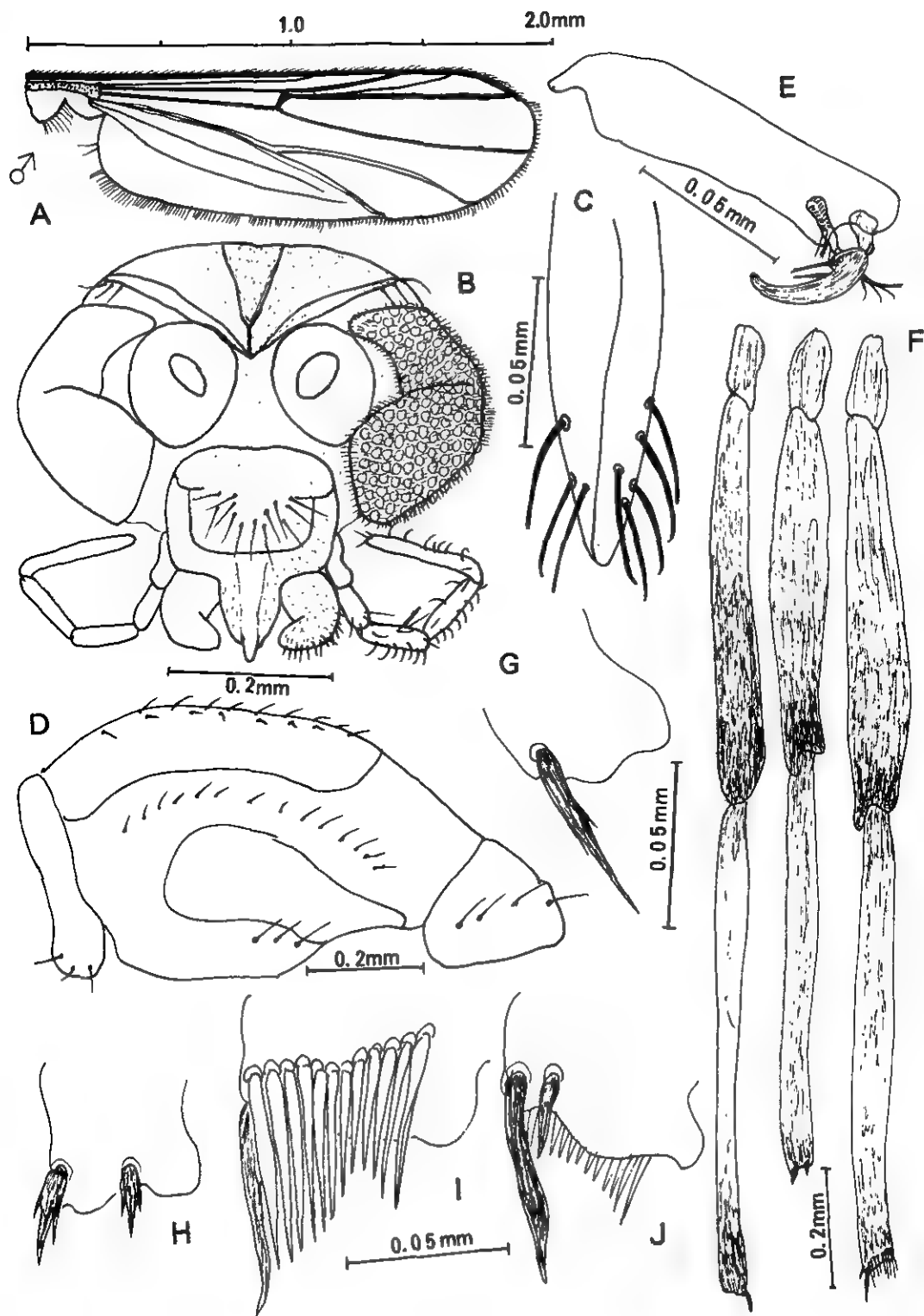


Plate 27. *Cricotopus tamasimplex*, sp. nov., male

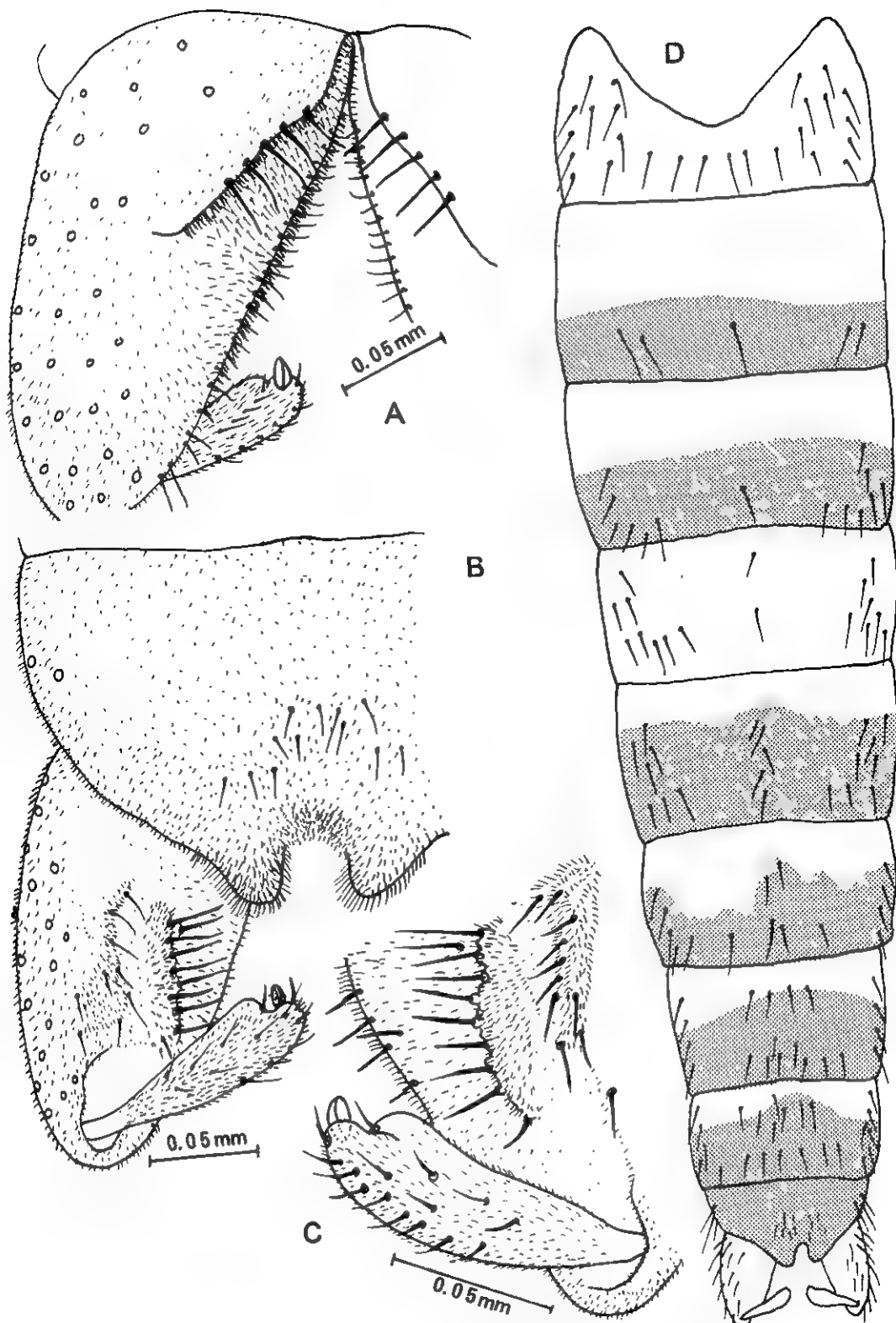


Plate 28. *Cricotopus tamasimplex*, sp. nov., male

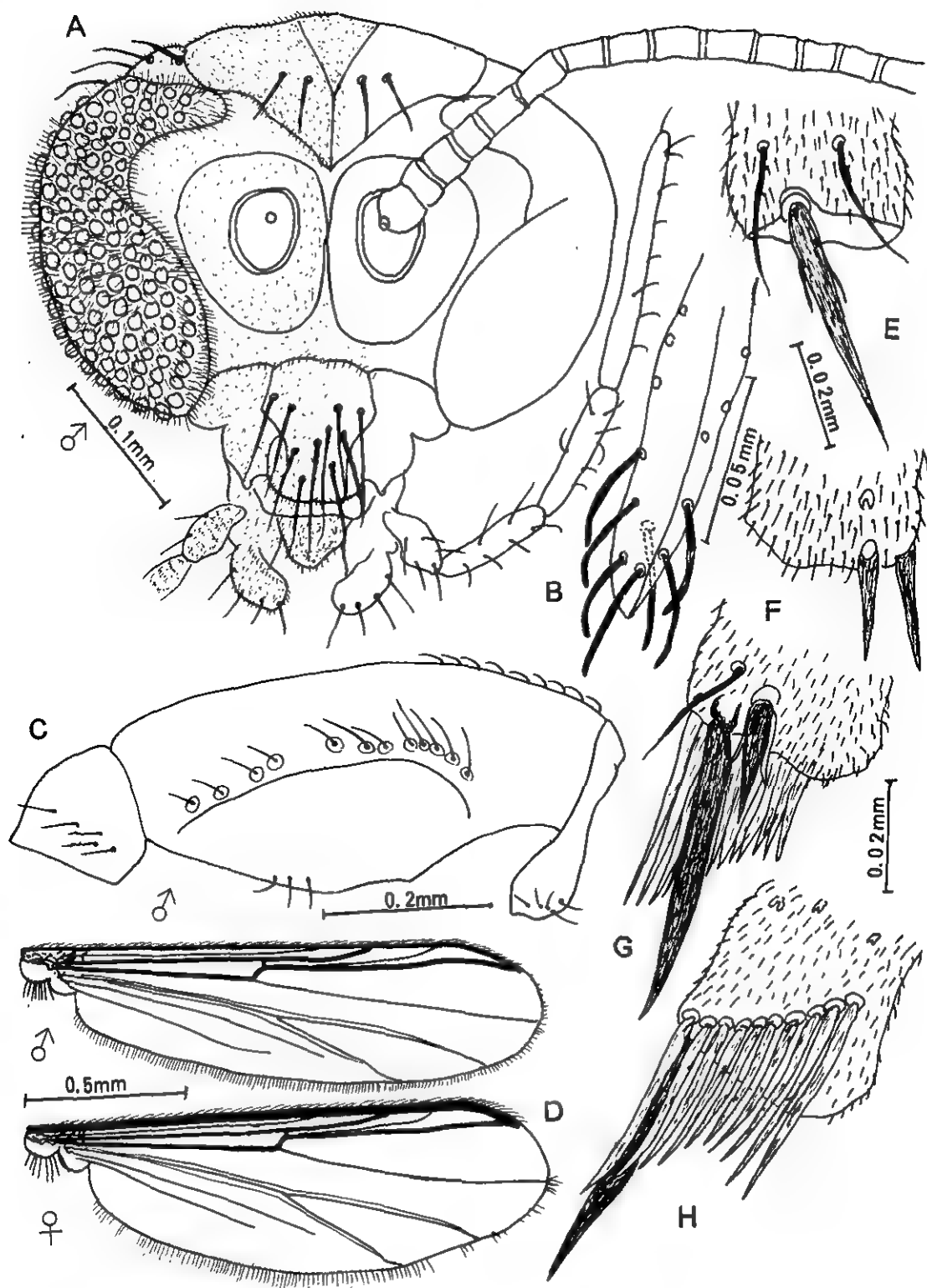


Plate 29. *Paratrichocladus tamaater*, sp. nov., male and female

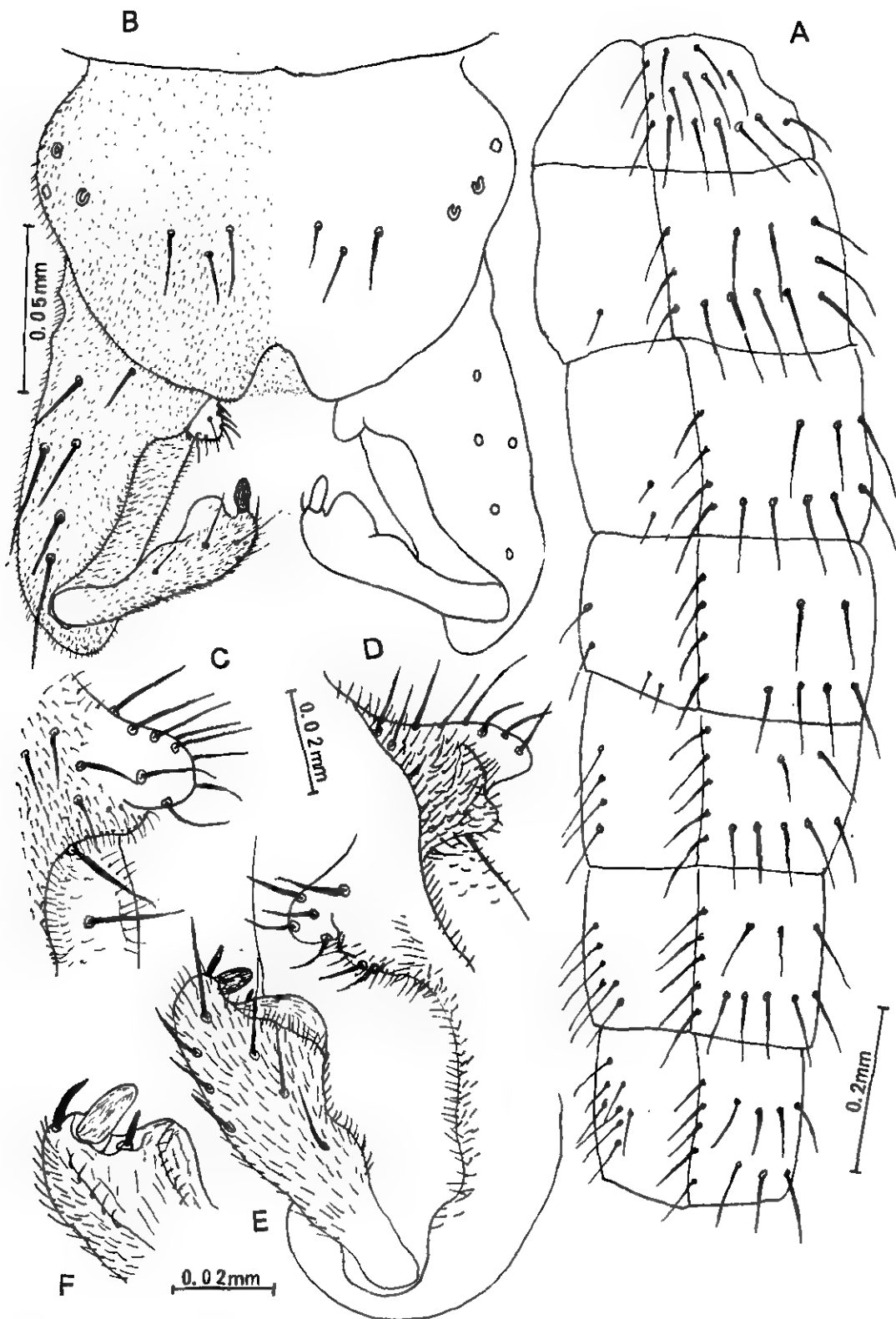


Plate 30. *Paratrachocladus tamaater*, sp. nov., male

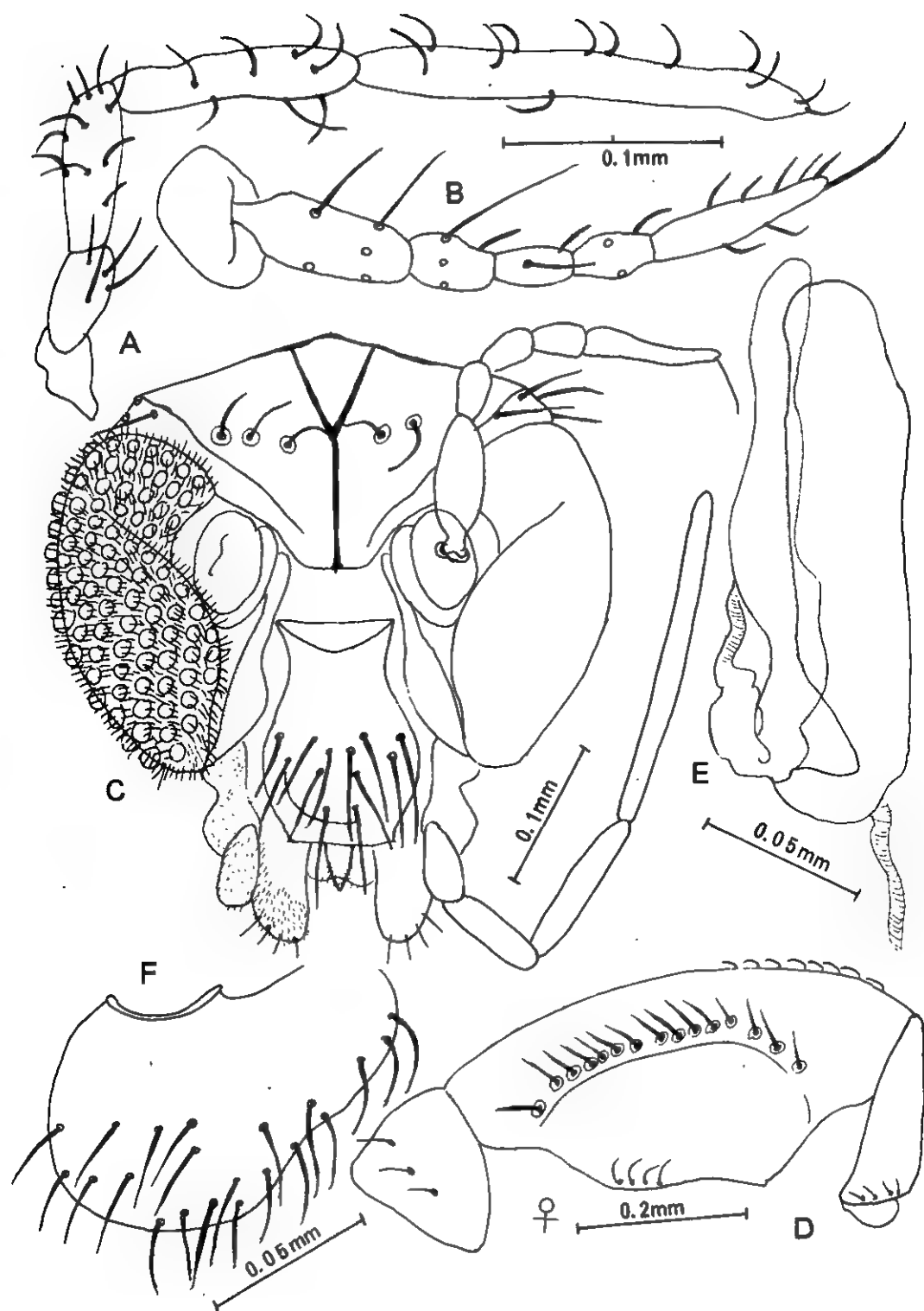


Plate 31. *Paratrichocladus tamaater*, sp. nov., female

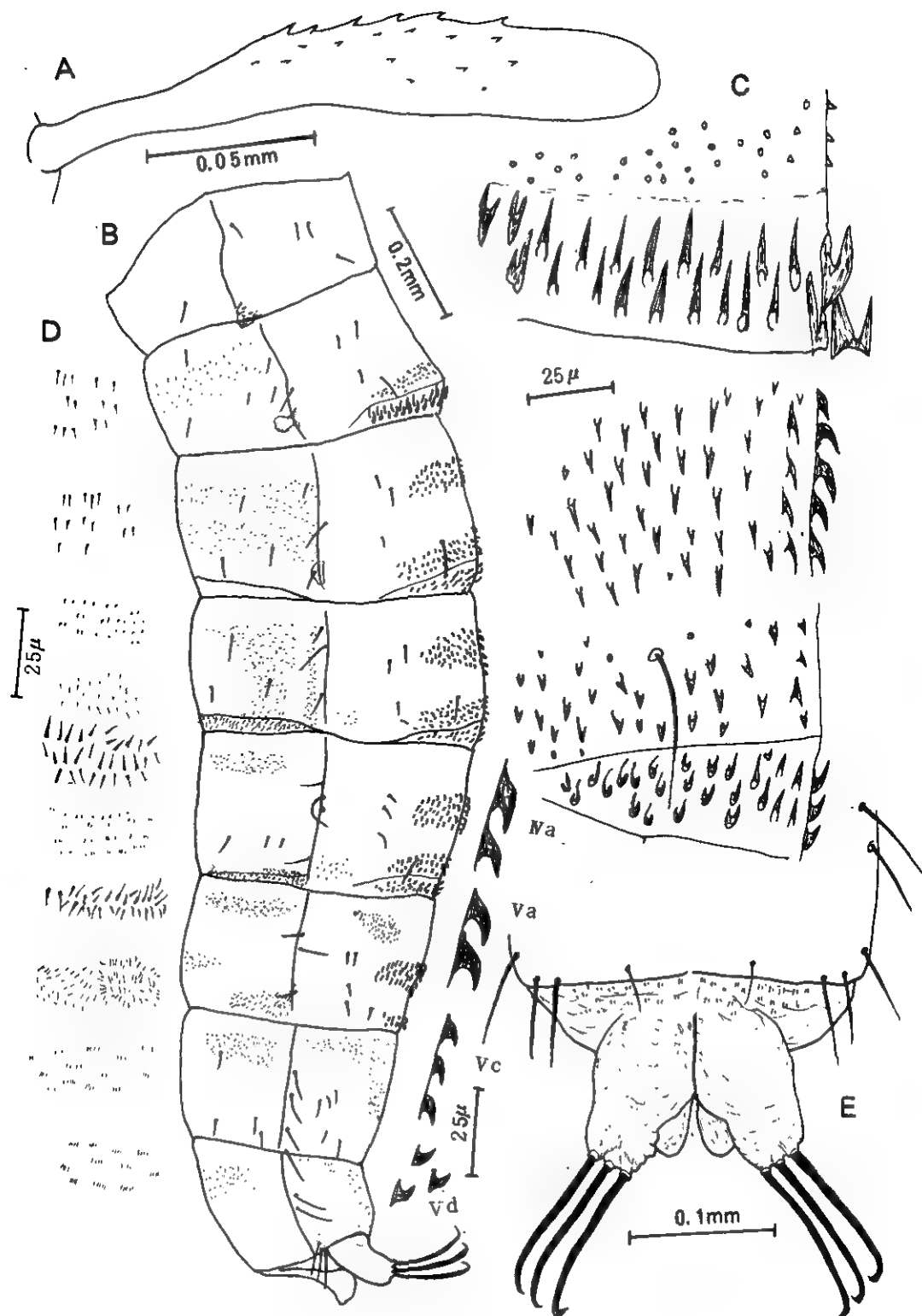


Plate 32. *Paratrachocladus tamaater*, sp. nov., pupa

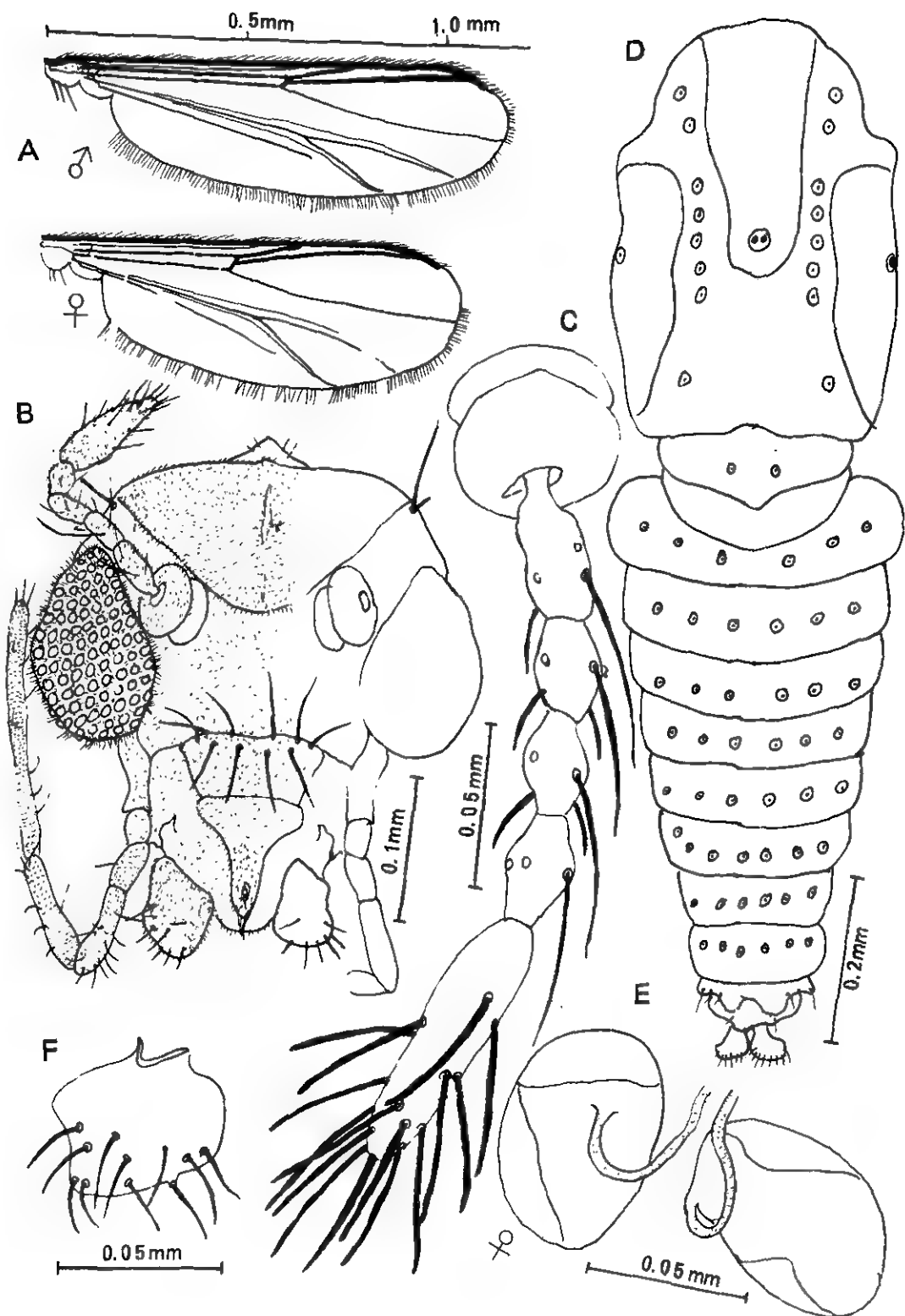


Plate 33. *Nanocladus tamabicolor*, sp. nov., male and female

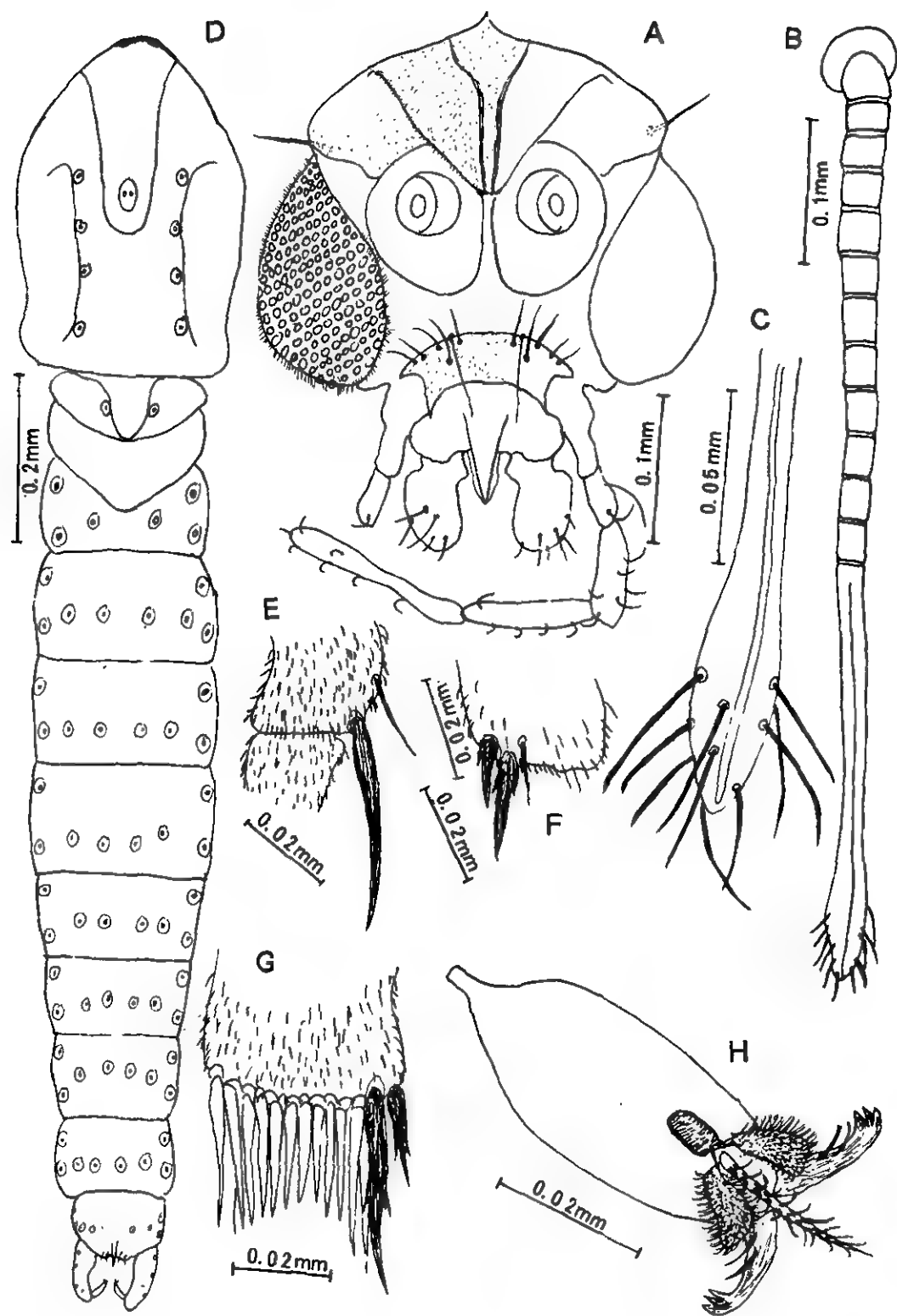


Plate 34. *Nanocladius tamabicolor*, sp. nov., male

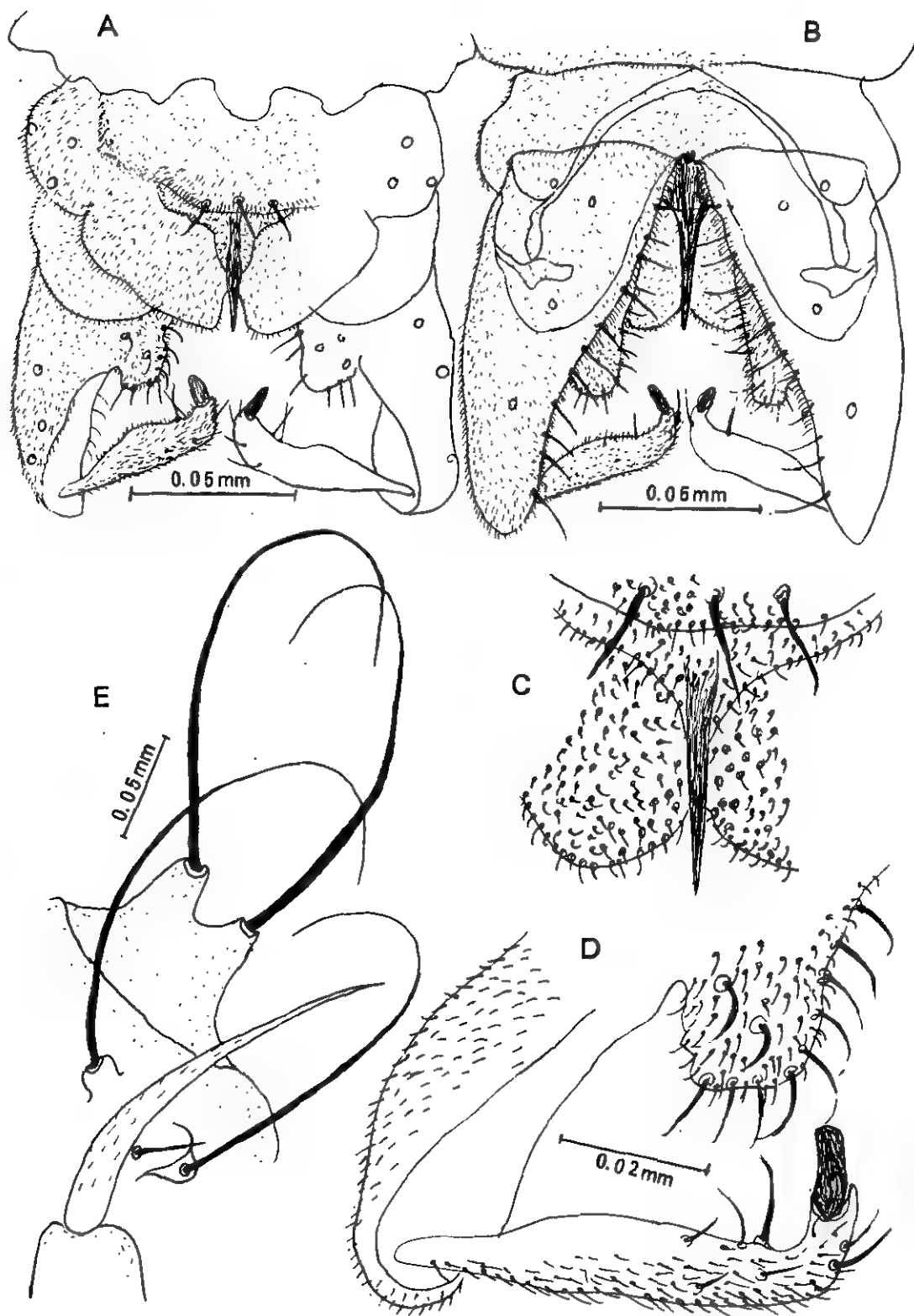


Plate 35. *Nanocladius tamabicolor*, sp. nov., male and pupa

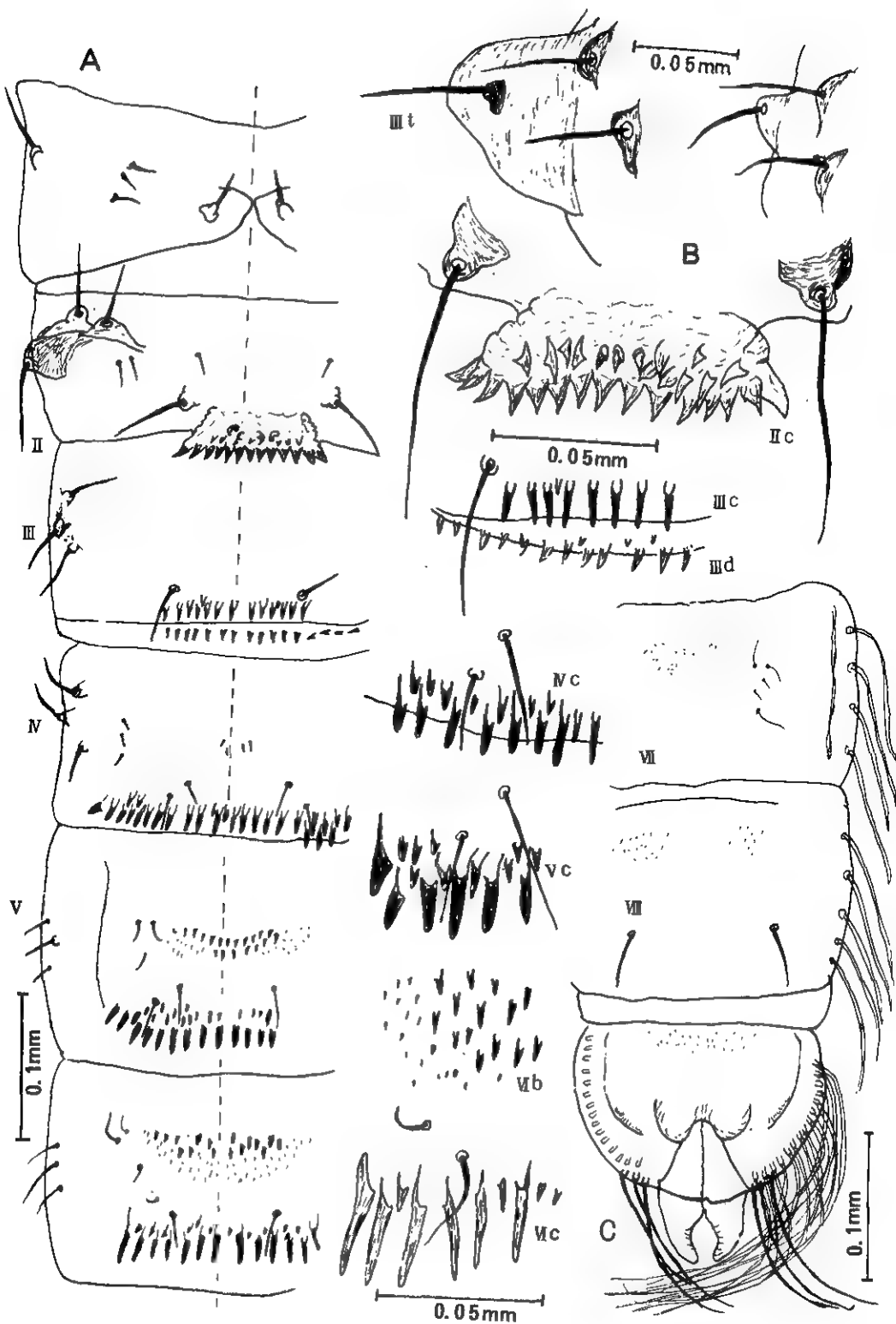


Plate 36. *Nanocladius tamabicolor*, sp. nov., pupa

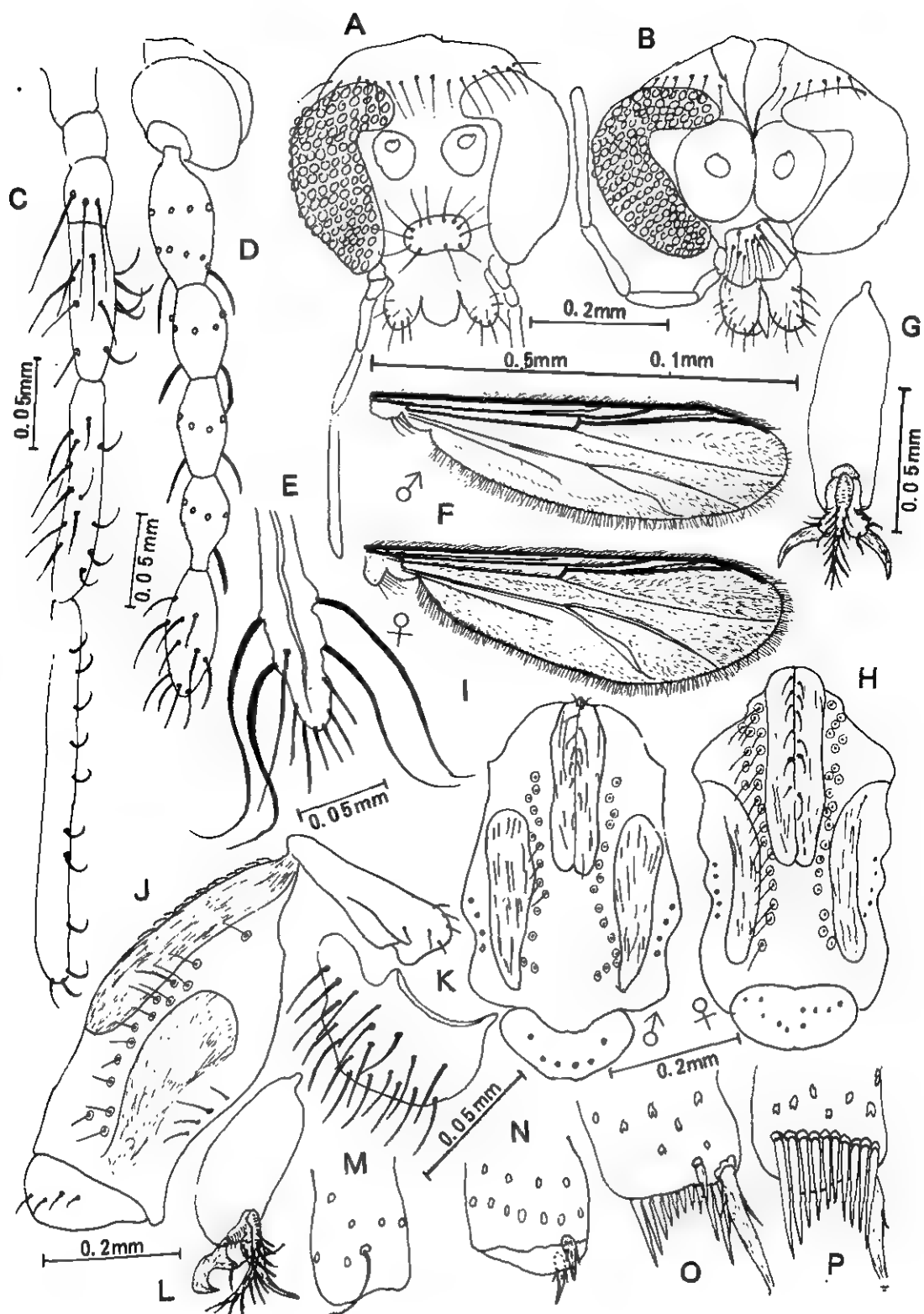


Plate 37. *Parametrioctenemus stylatus* (Kieffer), male and female

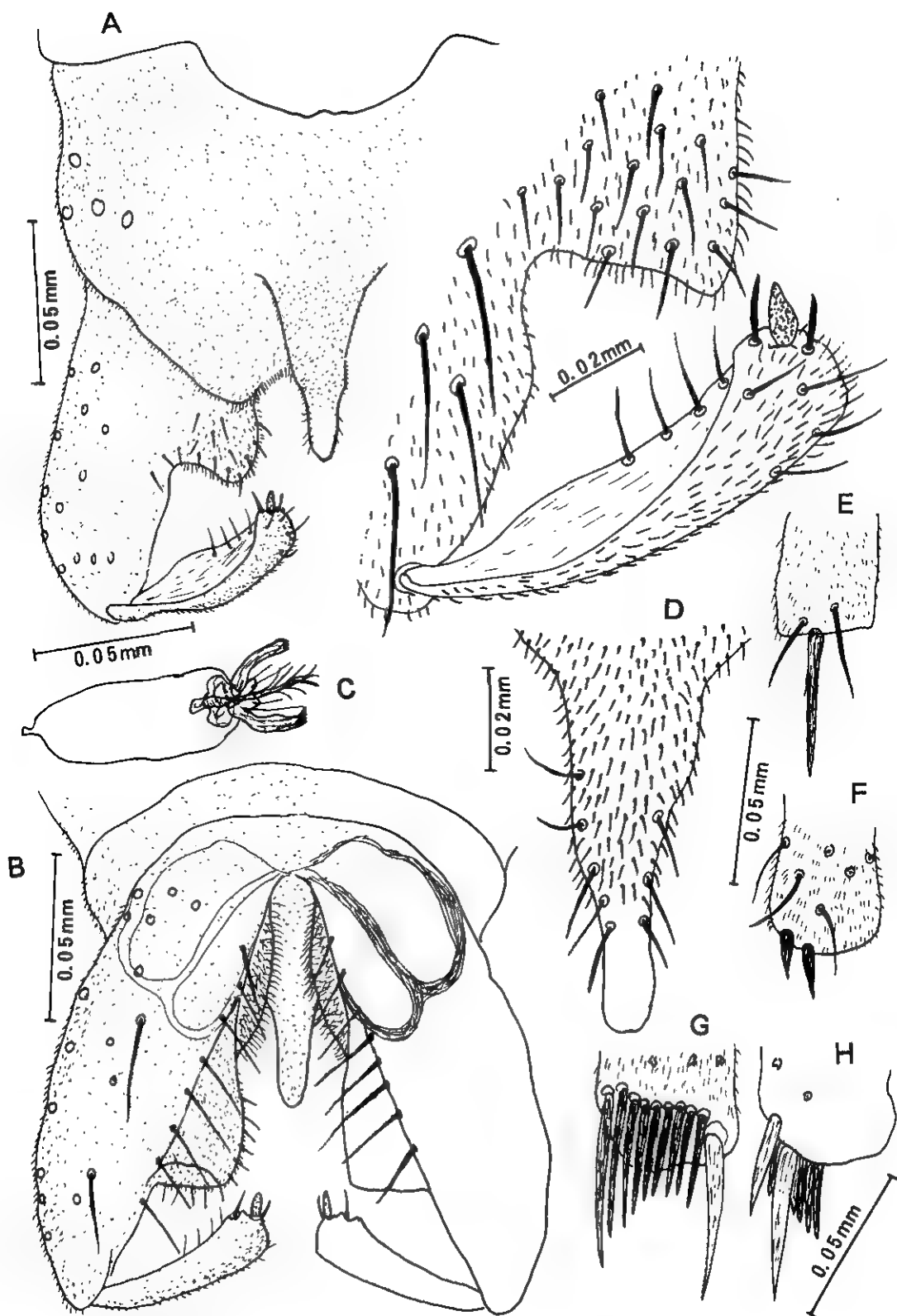


Plate 38. *Parametrioctenemus stylatus* (Kieffer), male

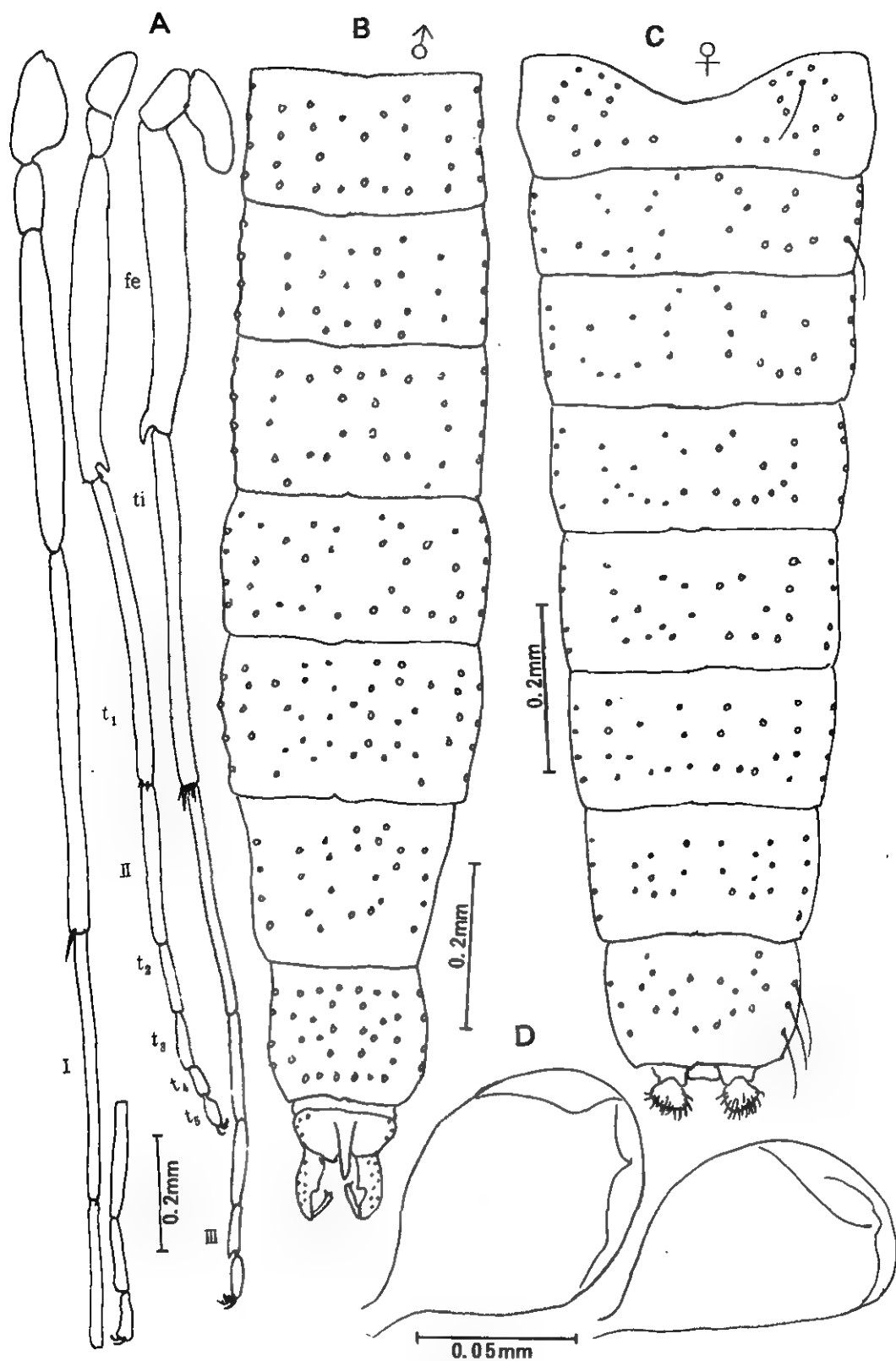


Plate 39. *Parametrioctenemus stylatus* (Kieffer), male and female

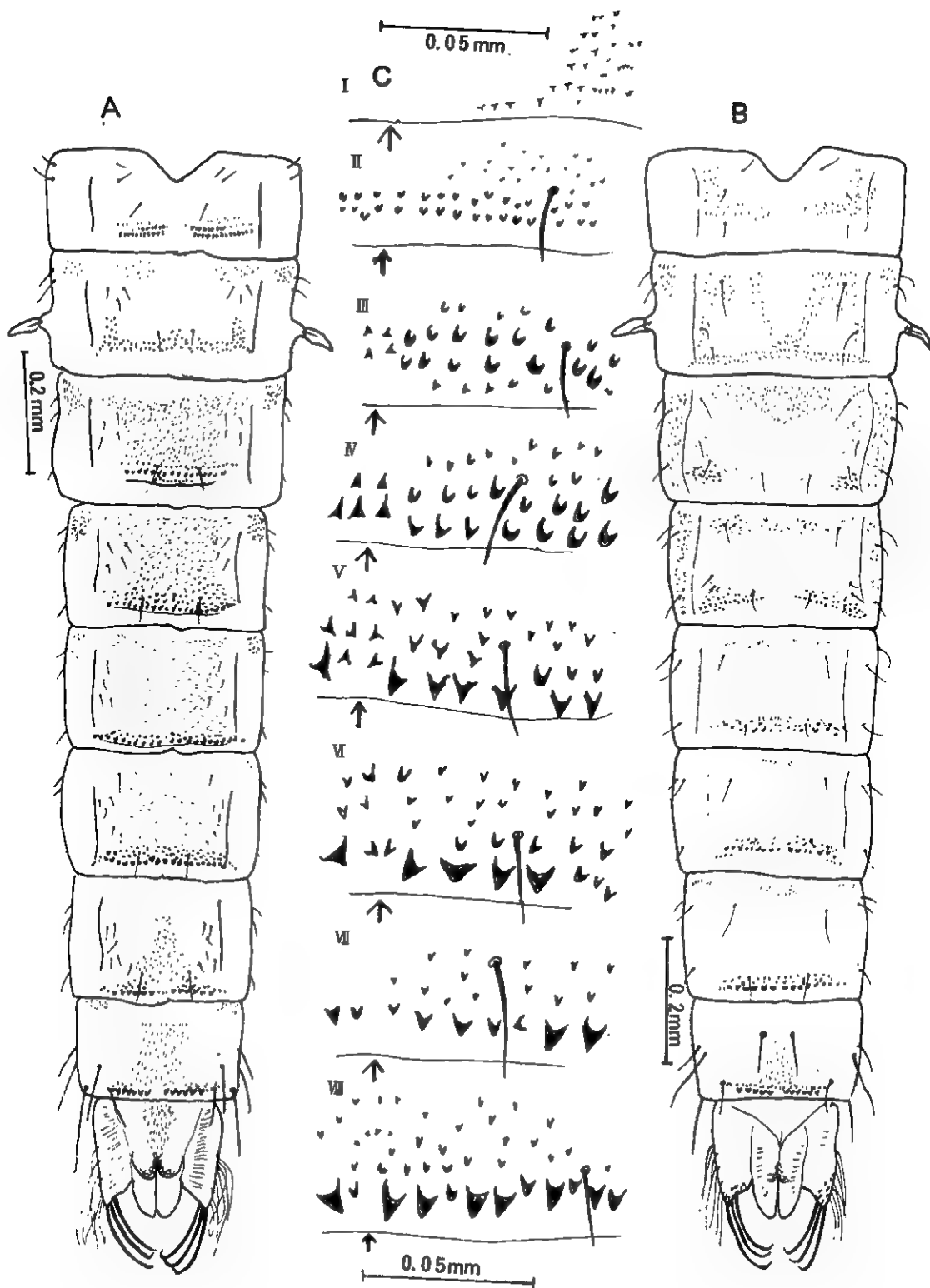


Plate 40. *Parametrioctenemus stylatus* (Kieffer), pupa

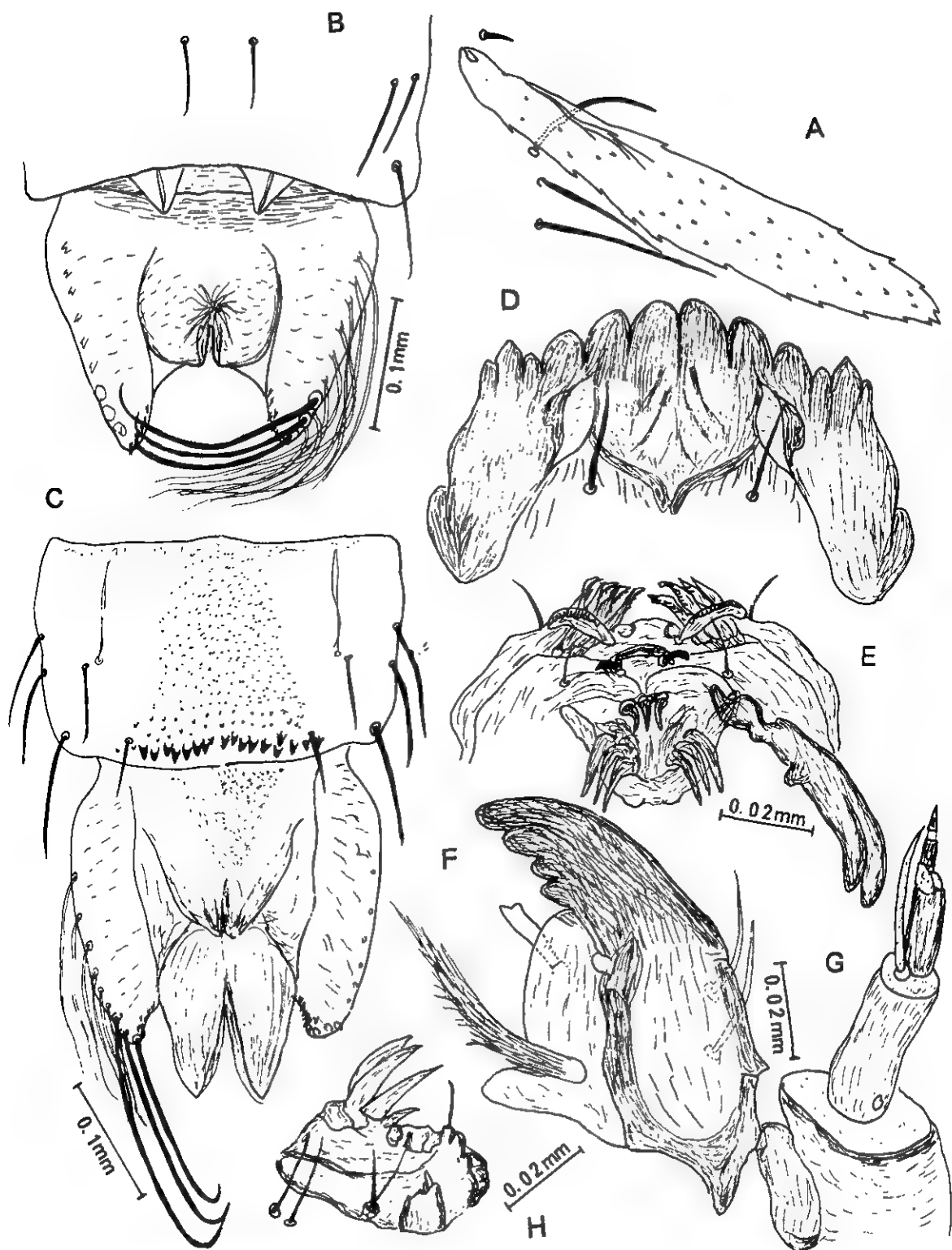


Plate 41. *Parametrioctenemus stylatus* (Kieffer), pupa (A–C), and larva (D–H)

多摩川に発生するユスリカ類の研究

第3報 夏期の調査で見出されたエリユスリカ亜科 Orthocladiinae 各種の記載と、その分布の下水汚染度との関係について

佐々学¹

私共は多摩川の一支流、南浅川について、その最上流部から、次第に周辺人家よりの下水が混入し、ついに八王寺市内を流れてその水の大部分が都市下水となる所まで、約2 km おきに6か所の採集定点をきめて水底の泥、石、植物などを半定量的に採集し、これを研究室内で保存してそれぞれの資料からユスリカ等の成虫を羽化させるという方法で、ユスリカ各種の分布を調査した。この報告は、1979年8月17日に採集した資料から回収された種類のうち表1に示すようにエリユスリカ亜科 Orthocladiinae に属する19種と、Tanypodinae 亜科に属する3種の分布と、その一部の種について各期の記載をまとめたものである。ユスリカ亜科 Chironominae に属する20種の分布と記載はすでに国立公害研究所報告第13号に第1報 (Sasa ら、分布) と第2報 (Sasa、記載) として報告した。この第3報に記述した種類は13で、うち5種はさしあたりヨーロッパから報告されたものと同種と同定したが、残り8種はわが国特産種とみなされ、うち徳永 (1936, 1939) が記載した2種以外は新種とみなさざるをえなかった。それらの分布は表1に示す通りで、この亜科の各種についても、(4), (5), (12) のように汚染の最も進んだ6号地点に多発し上流部には見出されないもの、(1), (2), (8), (9), (11), (13), (14), (17) のように下水の混入がない1号地点や、それがきわめて少ない2号、3号地点にのみ見出されるもの、(3), (10), (15), (18) のように中間地点にのみ見出されるもの、というようなすみ分けが認められた。

これら各種のうち、すでに Sasa (1979) の前報に記載した (4), (5) の2種を除き、雄 (11種)、雌 (8種)、サナギ (10種)、幼虫 (2種) の図説をあげた。

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Studies on chironomid midges of the Tama River*

Part 4.

Chironomidae recorded at a winter survey¹⁾

Manabu SASA²⁾

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- 1) Studies on Chironomidae of Japan. Part 10, from NIES.
- 2) The National Institute for Environmental Studies, Yatabe-machi, Tsukuba, Ibaraki 305, Japan.

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- Part 2 Sasa, M. (1978): Taxonomical and biological notes on *Tokunagayusurika akamusi* (Tokunaga), with description of immature stages (Diptera, Chironomidae). Jpn. J. Sanit. Zool. (Eisei Dobutsu), 29, 93-101.
- Part 3 Sasa, M. (1978): A comparative study of adults and immature stages of nine Japanese species of the genus *Chironomus* (Diptera, Chironomidae). Res. Rep. Natl. Inst. Environ. Stud., No. 3, 1-63.
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- Part 5 Sasa, M. (1979): A morphological study of adults and immature stages of 20 Japanese species of the family Chironomidae (Diptera). Res. Rep. Natl. Inst. Environ. Stud., No. 7, 1-148.
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- Part 10 Sasa, M. (1981): Studies on chironomid midges of the Tama River. Part 4. Chironomidae recorded at a winter survey. Res. Rep. Natl. Inst. Environ. Stud., No. 29, 79-148.

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INTRODUCTION

This paper is a report on results of a survey of the Minamiasakawa River, a tributary of the Tama River, conducted on 12 December 1979, by almost the same methods as used in the summer survey carried out in August 1979 by the same group of workers from NIES. Samples containing immature stages of chironomids were collected at the six fixed stations of the Minamiasakawa River, taken back in polyethylene bags, to the laboratory of NIES, and transferred to plastic tubs for rearing of adult midges. The tubs were then filled with water, air bubbles were introduced from a compressor, and covered with a nylon sheet to prevent escape of adult midges. The containers were kept in an insectarium regulated at 20°C, and adult midges emerged from each sample were collected with a sucking tube together with the pupal or larval exuviae.

Methods for preservation and examination of the specimens are as described in the previous paper (Sasa, 1980).

The adult chironomids recovered from samples collected at the six stations with different degrees of pollution with sewage waters are shown in Table 1. In total, 252 males and 279 females belonging to 23 species of subfamily Orthocladiinae or Chironominiinae were recovered and identified. Those belonging to Tanypodinae and Corynoneurinae are not included in this table. It has again been shown that distribution of each species according to the survey stations is more or less characteristic, suggesting that the chironomids can be used as excellent indicators of pollution of the river water. It was rather surprising that of a total of 23 species collected at the winter survey, only 8 of them were in common with those of the summer survey carried out in August at the same stations, and the rest 15 species were recovered only from the winter samples. Most of the chironomids collected from this river were again the species indigenous to Japan, and 10 among them are described here as new species.

DESCRIPTION OF SPECIES

(1) *Orthocladium (Orthocladus) tamanitidus*, sp. nov.

Materials studied. A total of 26 males and 28 females emerged from samples collected on 12 December 1979 at Station No. 2, a most unpolluted part of the Minamiasakawa River; 12 males and 6 females were dissected and mounted in gum-chloral, the rest adult are preserved dry. 10 pupal exuviae associated with adults were dissected and mounted in gum-chloral; 4 larval exuviae associated with pupae were available. Holotype: a male, emerged on 25 December, dissected and mounted in gum-chloral (No. A 57L01). Paratypes: 10 males and 6 females mounted in gum-chloral (Nos. A 57:04-13; 21-26); 5 males and 2 females, fixed on pin.

Male. Boday length 2.82-3.36 mm (3.39 mm in average of 9). Wing length 1.90-2.21 mm (2.07 mm in 8). Head, scutum, scutellum and postnotum almost uniformly shining black, scutal stripes hardly distinguishable. Halteres pale yellow. Abdominal tergites largely black, with faint pale bands along oral margins of tergites II-VI. Leg segments uniformly dark brown.

Head in Fig. 1 H. Antenna with 13 flagellar segments, AR 1.46-1.86 (1.66±12 in measurements of 10), last segment with several subterminal sensory setae (Fig. 1 I). Palp 4 segmented (53, 108, 109, 176 microns). Eyes with a conspicuous dorso-medial projection, ER 0.65-1.00 (0.80 in average of 9). Supraorbital setae 8-13. Clypeal setae 8-11.

Thorax in Fig. 2 J). Antepronotum without dorsal setae, with 3-6 lateral setae on each side. Scutum with 10-12 short dorsomedian setae, with 6-12 (most commonly 7 or 8) dorsolateral setae on each side all arising from large pale pits, and with 3-5 (most frequently 4) supra-alar setae on each side. Scutellum with 6-11 (most frequently 8) setae in a transverse row. Wing venation in Table 2-1 and Fig. 1 A. Wing membrane bare, almost colorless and very finely granulate. Anal lobe well produced. Squama with 12-21 fringe setae. R 2+3 ending about midway between ends of R 1 and R 4+5. fCu almost under r-m. Cu 2 nearly straight. An extending far beyond fCu. Relative length of leg segments in Table 3-11. fLR 0.71-0.77 (0.74 in average of 6), mLR 0.51-0.56 (0.53), hLR 0.57-0.62 (0.59). Front tibia with a long terminal spur (72 microns; Fig. 2 H); middle tibia with two short terminal spurs (25 and 20 microns; Fig. 2 E), middle tarsus I with two short terminal spurs (22 and 20 microns); hind tibia with a long terminal spur (58 microns), a short terminal spur (26 microns), and a terminal comb composed of 11 free spurs 26-48 microns long (Figs. 2 F, G), hind tarsus I with two short terminal spurs (26 and 22 microns); other leg segments without terminal spurs. Beards on tarsi I of moderate length, fBR 1.8-2.4, mBR 2.2-3.8, hBR 2.8-3.9. Pulvilli absent, claws and empodium well developed (Fig. 2 D).

Hairs on abdominal tergites fairly numerous and rather evenly distributed, those on tergites VII and VIII roughly in three longitudinal rows (Fig. 1 J). Hypopygium in Figs. 2 A, I. Anal point about 40 microns long, tapered to a point, dorsally free from microtrichiae and with about 5 stout lateral setae on both sides and 2 or 3 setae near the base, ninth tergite otherwise free from long hairs. Inner margin of gonocoxite with a pair of thumb-like process near the base bearing numerous hairs about 7 microns long, and a pair of inner lobes composed of a dorsal process (almost bare and apically rounded) and a ventral process (narrower and apically pointed, bears some 10 long

bristles); Figs. 2 B, C). Gonostylus narrow and apically curved inwards, with a spatulate terminal spine (Fig. 2 A).

Female. Body length 2.33–2.62 mm (2.48 mm in average of 6). Wing length 1.74–2.10 mm (1.92 mm in average of 6). Body coloration largely dark brown (not shining black as in male); ground color of scutum brown, scutal stripes dark brown, scutellum dark brown, postnotum nearly black, leg segments brown, abdominal tergites dark brown with faint pale bands along the oral margins, hypopygium dark brown (not white as in *Cricotopus* species).

Head in Fig. 1 D. Antenna with 5 flagellar segments (70, 36, 38, 39, 125 microns), segments II, III and IV nearly globular, last segment with numerous curved sensory setae (Fig. 1 E). Palp 5 segmented (31, 46, 96, 104, 169 microns), segment I without long hairs. Eyes bare, reniform, inner margin slightly concave, ER 0.83–1.11 (0.95 in average of 6). Supraorbital setae 7–12 (most frequently 10) on each side. Clypeal setae 11–15 (most frequently 11).

Thorax in Fig. 1 C. Antepronotum without dorsal setae, with 4–7 lateral setae on each side. Scutum with 12–16 short dorsomedian setae all arising from minute pits, 7–14 dorsolateral setae on each side all arising from large pale pits, and 3–5 (most frequently 4) pre-alar setae on each side. Scutellum with 8–13 setae in a transverse row. Wing venation in Table 1-1 and Fig. 1 A. Relative length of leg segments in Table 2-2. fLR 0.71–0.72, mLR 0.51–0.55, hLR 0.56–0.61. Front tibia with a terminal spur (29 microns long; much shorter than that of male); middle tibia with two short terminal spurs (24 and 17 microns), middle tarsus I with two short terminal spurs (22 and 16 microns); hind tibia with a long terminal spur (38 microns), a short terminal spur (17 microns), and a terminal comb composed of 12 free spines 25–40 microns long, hind tarsus I with two short terminal spurs (27 and 25 microns); other leg segments without terminal spurs. Spermathecae two, both dark brown, egg-shaped and similar in size, about 360 microns long and 240 microns wide. (Fig. 1 F). Cercus with a long and narrow lobe as in Fig. 1 G, 120 microns wide and 72 microns long.

Pupa. (measurements of 6 pupal exuviae associated with adult males). Length of abdomen 2.65–2.86 mm. Thoracic respiratory organs slender and horn-like, with pointed apex and not medially expanded, 253–310 microns long (290 microns in average of 6 pairs) and about 22 microns in diameter, with numerous small spinules on the entire surface as in Fig. 3 A. Distribution of spines and spinules on abdominal tergites in Figs. 3 B–F. Tergite II without oral and middle spinose areas, with a small middle spinose area bearing very small spines (II-c), and a small band of 32–56 recurved spines (average number 40.1, each measuring about 25 microns). Tergites III, IV and V each with a large middle spinose area which leaves the central part free of spines (V-b and V-c, for example; Fig. 3 F), and a caudal band of small recurved spines in roughly triple rows on the intersegmental membrane. Tergite VI with middle spinose area same as in tergites III to V, but caudal band of recurved spines is absent. Tergites VII, VIII and IX without spinose areas, and with basal spinulose areas as in Figs. 3 B, K. Segment I with one pair, II to VI with 3 pairs, VII and VIII with 4 pairs of lateral hairs, all short and simple (those on segment VIII are slightly expanded in the middle; Fig. 3 K). Sternites IV, V, VI and VII with a pair of caudolateral whirl-like spinose areas (Figs. 3 G–J). Anal segment in Fig. 3 K. Anal fins with 3 strong terminal setae of subequal length, 155–185 microns long according to the specimens, specialized spines are absent from their bases.

Larva. Body length of a mature larva 4.05 mm, head 0.42 mm long and 0.35 mm wide. With a large and a small eyes on each side, both clearly separated (Fig. 4 D). Labial plate 166 microns wide and 92 microns long, with a wide central tooth (30 microns wide) and 6 pairs of lateral teeth which are almost uniformly dark brown (Fig. 4 G). Antenna 5 segmented (48, 12, 6, 5, 4 microns; Fig. 4 B); first segment 1.67 times the combined length of segments II to V, with a ring organ near base; antennal blade 22 microns long and 0.75 times the combined length of segments II to V; Lauterborn's organ well developed, covering the lateral sides of segment III. Labrum, epipharynx and premandible in Figs. 4 E, F. Maxilla in Fig. 4 A. Mandible 147 microns long and 67 microns wide, with 6 cutting teeth; mandibular brush composed of a forked seta and a tree-like seta (Fig. 4 C). Claws on anterior pseudopods in Fig. 4 H. Preanal hair tuft composed of 6 long and 2 short hairs, their bases semiglobular (Fig. 4 I). Dorsal pair of anal fins 106 microns long, ventral pair 77 microns long, both with rounded apex (Fig. 4 J). Posterior pseudopods well developed, each with 16 claws (Fig. 4 K).

Discussion. This species was collected only from Station 2, where the river water is still very clean. Morphologically, it is a typical member of subgenus *Orthocladius*, s. str. Among the species known within this subgenus, it seems to be most closely related to *O. rhyacobi* in the structure of male hypopygium, especially in the presence of a finger-like process in the ventrobasal part of gonocoxite (Fig. 2 C). However, the present species bears long bristles on this lobe, while the hairs on the lobe of *O. rhyacobi* are very short (Pinder, 1978, Fig. 38 C). Body coloration, antennal ratio and most other characters in male are also similar to those given by Edwards (1929) for *Spaniotoma* (*Orthocladius*) *rhyacobi* (Kieffer), but the present species differs from it in the relative length of tarsus IV and V of posterior leg (in the former, IV is definitely shorter than V) and in the coloration of antennal hairs (whitish apically in the former, uniformly brown in the present species). The present species is also similar in general structure to *O. tamaputridus*, sp. nov., but both differ in the shape of gonocoxite lobes and gonostylus. In the pupa, the present species is characteristic in the small number of recurved spines on abdominal tergite II (II-d), in the shape of spinose areas on tergites II to V, and in the length and structure of thoracic respiratory organs and the terminal hairs of anal fins.

(2) *Orthocladius* (*Orthocladius*) *tamaputridus*, sp. nov.

Materials studied: 8 males and 10 females from bottom samples collected at Station No. 3, 7 males and 4 females from those at No. 4, 6 males and 2 females from those at No. 5, totaling 21 males and 16 females. 16 males (No. A 57:51-66) and 9 females (No. A 57:71-79) were dissected and mounted in gum-chloral, the rest specimens are preserved dry. Two male adults were mounted together with the associated pupal exuviae (No. A 57:56, 57); 5 additional pupal exuviae which were not directly associated with adults.

Male. Body length 2.70-3.51 mm (3.12 ± 0.22 mm in measurements of 16). Wing length 1.74-2.32 mm (2.06 ± 0.17 mm in 16). Body coloration largely shining black, i.e. ground color of scutum black, scutal stripes shining black and hardly distinguishable, scutellum brown, postnotum shining black, halteres brownish yellow, leg segments almost uniformly dark brown, abdominal tergites almost uniformly black.

Head in Fig. 5 D. Antenna with 13 flagellar segments, AR 1.56–1.78 (1.65 ± 0.07 in measurements of 14), terminal segment with about 10 curved sensory setae (Fig. 5 E). Palp with one basal hairless segment (30 microns long) and 4 haired segments (53, 120, 101, 157 microns). Eyes bare, with a fairly conspicuous dorsomedial projection, ER 0.86–1.12 (0.98 ± 0.07 in measurements of 14). Supraorbital setae 8–14 (most frequently 10). Clypeal setae 10–16 (most frequently 10).

Thorax in Fig. 5 F. Antepronotum without dorsal setae, with 4, 5 or 6 lateral setae on each side. Scutum with 8–14 short dorsomedian setae, 7–11 (most frequently 8) dorsolateral setae on each side all arising from large pale pits, and 3–5 (most frequently 4) supra-alar setae on each side. Wing venation in Table 2-2 and Fig. 5 A. Squama fringed with 12–20 setae. Anal lobe rectangularly produced. R 2+3 separated from R 1 and R 4+5, ending about midway between ends of R 1 and R 4+5. Costa slightly extending beyond tip of R 4+5 (95% and 93% of wing length). fCu almost under r-m (36% and 34%). Relative length of leg segments in Table 3-2. fLR 0.68–0.73 (0.711 ± 0.17 in 11), mLR 0.49–0.57 (0.525 ± 0.33 in 14, most frequently 0.51), hLR 0.56–0.59 (0.568 ± 0.010 in 12). Front tibia with a long terminal spur (65 microns, Fig. 6 H), middle tibia with two short terminal spurs (31, 27 microns, 6 I), middle tarsus I with two short subterminal spurs (24, 23 microns), middle tarsus II with one short subterminal spur (21 microns), hind tibia with a long terminal spur (53 microns), a short terminal spur (31 microns), and a terminal comb composed of 12 free spines (52–20 microns; Figs. 6 J, K), hind tarsus I with two short subterminal spurs (27, 26 microns), other leg segments without spurs. Tarsi with moderately long beards, fBR 1.7–2.7, mBR 2.5–3.7, hBR 2.9–4.2. Pulvilli absent, empodium small (Fig. 6 L).

Abdominal tergites with numerous setae as in Figs. 5 H, I. Hypopygium in Figs. 6 A, B. Anal point sharply angulate, with pointed apex. Ninth tergite with about 10 setae on both sides of anal point (Fig. 6 C). Inner margin of gonocoxites with a pair of setigerous conical lobes near the base, and a pair of inner lobes composed of a short, rounded and almost bare dorsal lobe, and a longer, conical ventral lobe bearing about 10 long setae (Figs. 6 B, F, G). Gonostylus very wide and Chinese spoon-shaped (Figs. 6 D, E).

Female. Body length 2.28–2.82 mm (2.62 mm in average of 8). Wing length 1.82–2.10 mm (1.96 ± 0.01 mm in measurements of 12 specimens). Body coloration generally paler (more brownish) than in male; ground color of scutum yellow, scutal stripes dark brown, scutellum brown, postnotum and abdominal tergites dark brown, halteres pale yellow, leg segments brown.

Head in Fig. 5 B. Antenna with 5 flagellar segments (Fig. 5 C). Palp composed of a basal segment without a bristle, and 4 segments with bristles (55, 89, 82, 164 microns). Eyes bare, reniform, with a concave inner margin, ER 0.79–1.00 (0.92 in average of 6). Supraorbital setae 7–10 on each side (most frequently 8). Clypeal setae 12–15. Antepronotum bare dorsally, with 6 or 7 lateral setae on each side. Scutum with 10–14 short dorsomedian setae, 8 or 9 dorsolateral setae on each side, and 3 or 4 supra-alar setae on each side. Scutellum with 8, 9 or 10 setae in a transverse row. Wing venation in Table 2-2 and Fig. 5 A. Squama fringed with 14–21 setae. Relative length of leg segments in Table 3-2. fLR 0.69–0.77, mLR 0.51–0.56, hLR 0.57–0.63. Tip of front tarsus V in Fig. 5 G, pulvilli absent, claws simple apically and with several basal setae. Spermathecae in Fig. 5 J. Cercus in Fig. 5 K.

Pupa. Length of abdomen 2.47–2.78 mm (2.62 mm in average of 7). paler than in *O. tamanitidus*. Thoracic respiratory organs (Fig. 7 A) horn-like, with numerous

spinules, length 254–311 microns (284 in average of 7 pairs). Distribution of spines and spinules on abdominal tergites in Fig. 7 B. Tergite II with a central spinose area bearing very small spines, (II-b, II-c), and a caudal band of 28–43 large recurved spines arranged roughly in two transverse rows (34.5 in average of 8, fewer than in related species). Tergites III to V with a central spinose area bearing spines larger than in tergite II, and a caudal band of small recurved spines. Tergite VI with a central spinose area similar to that of tergites III to V, but without caudal band of recurved spines. Central spinose areas on tergites II to VI with a pair of segmented and spineless areas in the middle (Figs. 7 B, E). Tergites VII, VIII and IX with spinulose areas as in Figs. 7 B, G. Sternites IV–VII with a pair of whirl-like spinose areas in the caudolateral corners (Fig. 7 F). Segments I with one pair, II to VI with 3 pairs, VII and VIII with 4 pairs of lateral hairs, all simple and relatively short. Anal fins without fringe hairs and with 3 stout and curved terminal hairs, which are subequal in length within the same specimens, length 165–214 microns (190 microns in average of 8 specimens; Fig. 7 G). Anal fin with 1 or 2 small spines at the base of innermost terminal seta (Fig. 7 H).

Discussion. This species is almost identical in body coloration and size to *O. tamanitidus*, which was recovered at the same time from Station 2. Antennal ratio falls in the same range (1.46–1.86, or 1.66 in average in *tamanitidus*; 1.56–1.78, or 1.65 in average in the present species). The structure of male genitalia is also quite similar. The most remarkable difference is seen in the shape of gonostylus, being much broader in the present species than in *tamanitidus*. In the pupa, the size and shape of spinose areas on abdominal tergites II to VI are different between the two species, being larger and with a pair of bare spots in the present species, while these are smaller and with a large central bare area in *tamanitidus*. The present species is also similar in body coloration and general structure to *O. yugashimaensis*, which is found coexisting in the more polluted part of the river, but the latter is much larger in body size and in antennal ratio (2.2–2.6), and with differently shaped inner lobe of gonocoxite. In the pupa, *yugashimaensis* has longer thoracic respiratory organs, more numerous recurved spines on abdominal tergite II, and larger spinose areas on tergites II to VI.

(3) *Orthocladus (Orthocladus) yugashimaensis*, (Sasa, 1979)

Materials studied: 16 males and 14 females were reared from samples collected at Station No. 5, and 9 males and 7 females were obtained from those of No. 6, both with associated or accompanied pupal skins (Slide No. A 58:51–68).

Note: This species was described by Sasa (1979, p. 23, Plates 37–39) with adults, pupae and larvae collected from riverbeds of Kanogawa, Yugashima Town of Shizuoka Prefecture, and Imori, Nagasaki Prefecture, both from waters highly polluted with sewage discharges. The stations from where this species was discovered were also the most polluted parts of the Minamiasakawa River, but only during the winter season and not at the survey made in the summer.

Adults of this species is similar in body coloration and structure to those of the preceding two species which are coexisting in the same river, but are differentiated by the larger body size, higher antennal ratio (2.2–2.6 in this species), and the structure and size of gonostylus and inner lobes of gonocoxite, and in the structure of pupa, as discussed previously.

(4) *Orthocladius (Orthocladius) tamarutilus*, sp. nov.

Materials studied. 7 males and 8 females were reared from samples collected at Station Nos. 3, 4 and 5 of Minamiasakawa. A male and a female among them were fixed on pin, the rests, including holotype (A 58:01) and paratypes (A 58:02–04 males, 06–10 females) are mounted in gum-chloral. 7 pupal exuviae associated with the adults were also collected.

Male. Body length 2.51–2.69 mm (2.56 mm in average of 4). Ground color of scutum yellow, scutal stripes reddish brown, scutellum brown basally and largely yellow, postnotum basally brown but largely black, abdominal tergites black. Halteres white, with a small brown spot at apex. Leg segments almost uniformly yellowish brown.

Head in Fig. 8 F. Antenna with 13 flagellar segments, AR 1.12–1.49 (1.37 in average of 4). Last segment slightly expanded near apex, and with some 8 curved sensory setae (Fig. 8 G). Palp 4 segmented (46, 80, 89, 164 microns). Supraorbital setae 6–8 on each side. Clypeal setae 5, 6, or 8.

Anteprepronotum without dorsal setae, and with 2–5 lateral setae on both sides (Fig. 8 I). Setae on scutum and scutellum in Fig. 8 H. Dorsomedian setae of scutum 12, 14, 18, 18, 18 in 5 specimens examined, all roughly in double rows, all minute and decumbent, about 20 microns long. Dorsolateral setae 11–13 on each side, each about 26 microns long, their pits being small and not surrounded by pale ring. Supra-alar setae 4 (5 in one specimen) on each side. Scutellum with 7–9 (most frequently 8) setae in a transverse row. Wing venation in Fig. 8 A and Table 2-4. Squama with 8–10 fringe setae. Anal lobe rectangularly produced. R 2+3 separated from both R 1 and R 4+5, ending closer to end of R 1 than to end of R 4+5. Costa extending slightly beyond end of R 4+5 (97%:94%). fCu slightly beyond r-m (51%:47%). Cu 2 almost straight. An extending beyond fCu. Wing membrane bare, slightly tinted by brown, very finely dotted with microtrichiae. Relative length of leg segments in Table 3-4. fLR relatively high, 0.69–0.75 (0.715 in average of 4); mLR 0.49–0.53 (0.51 in 4); hLR 0.57–0.64 (0.61 in 4). In the type specimen, front tibia with a long terminal spur (43 microns; Fig. 9 F); middle tibia with two short terminal spurs (26 and 22 microns; Fig. 9 E), middle tarsus I with two short terminal spurs (19 and 17 microns), middle tarsus II with a terminal spur (20 microns); hind tibia with a long terminal spur (53 microns), a short terminal spur (25 microns), and a terminal comb composed of 10 free spurs (38–25 microns; Figs. 9 G, H), hind tarsus I with a short subterminal spur (21 microns). Hairs on tarsi relatively short, fBR 1.5–2.0, mBR 1.5–2.8, hBR 1.3–2.9. Pulvilli absent.

Abdominal tergites with reduced numbers of setae arranged in roughly 3 or 4 pairs of longitudinal rows (Fig. 9 I). Hypopygium in Figs. 9 A, B, D. Ninth tergite without dorsal setae. Anal point long and slender, pointed apically, with several lateral setae on both sides, but without microtrichiae (Fig. 9 C). Inner lobe of gonocoxite dorsally finger-like and without microtrichiae, bears about 10 stout setae along the margin (Fig. 9 B), ventrally thickly covered with microtrichiae (Fig. 9 D). Gonocoxite with a triangular projection on the ventral side near the base, bearing numerous microtrichiae (Fig. 9 D). Gonostylus slender, slightly tapering apically and concave medially, with a spatulate terminal spur 20 microns long and 10 microns wide, and with accessory spines (Fig. 9 B).

Female. Body length 1.40–1.91. Wing length 1.44–2.05. Ground color of scutum yellow, scutal stripes brown, scutellum yellow, postnotum dark brown, halteres entirely pale yellow, leg segments almost uniformly yellowish brown, abdominal tergites largely dark brown with marginal parts yellowish.

Head in Fig. 8 B. Antenna with 5 flagellar segments, segments II, III and IV nearly globular, last segment with some 12 curved sensory setae (Fig. 8 C). Palpi with 4 segments (41, 94, 92, 152 microns). Eyes reniform, with a slight dorsomedial projection, ER 0.78–1.00 (0.92 in average of 5). Supraorbital setae 7 in 4, 9 in one specimen, on each side. Clypeal setae 8, 8, 10, 12, 14 in 5 specimens examined.

Anteprenotum with 3 or 4 lateral setae. Setae on scutum and scutellum in Fig. 8 D. Scutum with 15–18 dorsomedian setae, all minute and decumbent; dorsolateral setae 7, 11 or 12 on each side, all arising from small pits without pale rings. Scutellum with 8–12 setae in a transverse row. Wing venation in Fig. 8 A and Table 2-4, wider than in male, but otherwise similar to male wing. Relative length of leg segments in Table 3-4, structure similar to male. Spermathecae nearly globular and brown (63x58; 61x55 microns; Fig. 8 J). Cercus long and ear-like, 157 microns long and 77 microns wide (Fig. 8 K).

Pupa. (measurements with 7 exuviae). Color of exuviae brown (darker than that of *Orthocladus yugashimaensis* and *O. tamaputridus*). Length of abdomen 2.02–2.45 mm (2.25 mm in average of 7). Thoracic respiratory organs (Fig. 10 A) tube-like, with only a few spinules, 180–213 microns long and about 22 microns wide (average length 196 microns). Distribution of spines and spinules on abdominal tergites in Fig. 10 B. Tergite II without oral and central spinose or spinulose areas (II-a, II-b absent), with a band of very small spines near the caudal margin (II-c), and a double or triple band of 56–76 (65.7 in average) large recurved spines (about 20 microns long) on the intersegmental membrane (Fig. 10 C). Tergites III and IV with 3 separated bands of spines as in Figs. 10 B, D, E, and the recurved spines on intersegmental membranes are about 5 microns long and much shorter than those on tergite II. Tergite V with a pair of basal spinose areas, transverse bands of central and caudal spinose areas, and a band of small recurved spines on the intersegmental membrane. In tergite VI, the band of recurved spines on intersegmental membrane is absent. Tergites VII and VIII with a pair of basal spinulose areas. Sternites II to VIII with spinulose areas; in addition, sternites IV to VII with a pair of whirl-like spinose areas in the caudolateral corners, which are especially large and conspicuous in sternites V and VI. (Figs. 10 F–H). Abdominal segment I with 1 pair, segments II to VII with 3 pairs (the second pair longer than the rests), VIII with 4 pairs of lateral hairs, all simple and short. Anal segment with a basal spinulose area on tergite and sternite, and a pair of anal fins bearing 3 strong and hooked terminal setae subequal in length (0.15–0.18 mm, Fig. 10 J).

Discussion. Adults of this species can be easily differentiated from the other coexisting *Orthocladus* species by the body size and color (small, reddish), and by the structure of male hypopygium. This species is regarded as a member of subgenus *Orthocladus* in the strict sense, because the anal point is narrowly triangular and with pointed apex, scutal setae are arranged in a transverse row and not irregularly distributed, and gonocoxite has a conspicuous inner lobe. Among the known species of this subgenus, the present species is apparently closest to *O. rubicundus* (Meigen) and *O. rhyacobi* (Kieffer) in body coloration and the structure of male hypopygium, but differs from both in the shape of gonostylus and inner lobe of gonocoxite, and also from the latter in that tarsus IV of hind leg is not shorter than tarsus V. In the pupa, the size and structure of thoracic respiratory organs and the distribution of spinose areas on abdominal tergites are characteristic to this species.

(5) *Orthocladius (Euorthocladius) kanii* (Tokunaga, 1939)

Materials studied. A male, with associated pupal skin, emerged on 14 December 1979 from a sample collected at Station No. 2, dissected and mounted in gum-chloral (No. A 57:91). A female, emerged on 27 December from the same sample (No. A 57:92); her larval skin mounted together with other pupal exuviae (No. A 57:93).

Note: This species was described as a new one by Tokunaga (1939) by the scientific name of *Spaniotoma (Orthocladius) kanii* from torrential streams in the suburbs of Kyoto. Tokunaga (1964) gave additional accounts on morphology and biology of this species found in Nagaoka, Niigata Prefecture. Sasa (1979) gave detailed description of male, female, pupa and larva collected in large numbers from a mountain stream of Tsukuba, Ibaraki. The larval habitat of this species is apparently clean, mountain streams.

(6) *Cricotopus sylvestris* (Fabricius, 1794)

Only a female specimen of this species was recovered from Station No. 6 of Minamiasakawa at the winter survey, though this species was found in large numbers at the same station in the summer survey. Description of adults and immature stages in Sasa (1979, p. 39, Plates 60–63).

(7) *Cricotopus bicinctus* (Meigen, 1818)

A total of 66 males and 35 females were recovered from samples collected at Stations No. 3 to No. 6 of Minamiasakawa, indicating that this species prefers the more polluted parts of the river for the larval breeding. In constant to the preceding species, this species was found to be more widely distributed in the river during the winter season than in the summer. Morphological accounts were given by Sasa (1979, p. 37, Plates 56–59).

(8) *Cricotopus tamadigitatus*, sp. nov.

Materials studied. Holotype: a male (No. A 56:51), emerged 19 December 1979, from a sample collected at Station No. 2. Paratypes: 8 males, emerged from samples of Station No. 2 during 19–27 December, dissected and mounted in gum-chloral (Nos. A 56:52–58); 5 males, emerged also from samples of Station No. 2 on 25 (4) and 30 (1) December, fixed on pin; 2 males, emerged on 27 or 30 December from a sample of Station No. 1, mounted in gum-chloral; (Nos. A 56:59, 60); 5 females, all emerged from samples of Station No. 2 and mounted in gum-chloral (Nos. A 56:56, 57, 58, 61); 2 females, from samples of Station No. 2, fixed on pin. 9 pupal exuviae associated with the adults and mounted in gum-chloral together with the corresponding adults. All specimens of this species were collected either from Station No. 2 or No. 1, the most oligotrophic parts of the river, and only at the winter survey but not at the summer survey of the same stations.

Male. Body length 2.41–3.13 mm (2.85 mm in average of 9). Wing length 1.51–1.95 mm (1.78 mm in average of 10). Ground color of scutum yellow, scutal

stripes, scutellum and postnotum dark brown, halteres pale yellow, coxae and trochanters of all legs yellow, the other leg segments almost uniformly brown, excepting front tibia, which has a broad pale ring from about basal 1/10 to 6/10 of the shaft, leaving dark rings on the proximal end and on the distal 4/10 (Fig. 13 C). Abdominal tergites I and II pale yellow, III to VIII black, hypopygium white (Fig. 13 A).

Head in Fig. 11 D. Antennal flagellum 13 segmented, AR 0.91–1.12 (1.00 in average of 8). Palp 4 segmented (53, 106, 108, 183 microns). Eyes highly pubescent, with a conspicuous dorsomedial projection, ER 0.42–0.74 (0.55 in average of 9). Supra-orbital setae 6–9 (7.6 in average of 14) on each side. Clypeal setae 12–18 (15.5 in average of 8).

Thorax in Fig. 13 B. Scutal stripes united in the middle, dorsomedian setae minute, about 15 microns long, 15–22 in double rows. Dorsolateral setae also minute and decumbent, about 22 microns long, arising from small pits, 12–16 on each side. Supraalar setae usually 3 (rarely 4). Scutal setae 8–12 (most commonly 12) in two transverse rows. Wing venation in Fig. 11 C and Table 2-8. Wing membrane bare, slightly brown. Anal lobe rather flat. R 2+3 running close to R 4+5 but ending almost midway between tips of R 1 and R 4+5. Costa extending slightly beyond end of R 4+5. Cu 1 ending proximal to end of R 4+5. Squama with 4–7 (most frequently 7) hairs. Relative length of leg segments in Table 3-8. fLR 0.62–0.68 (0.66 in average of 6), mLR 0.48–0.52 (0.50 in average of 6), hLR 0.55–0.57 (0.56 in average of 6). Front tibia with a long terminal spur 48 microns long (Fig. 13 D), middle tibia with 2 short terminal spurs 36 and 35 microns long (Fig. 13 E), hind tibia with a long terminal spur 68 microns long, a short terminal spur 32 microns long, and a terminal comb composed of 13 spurs 50–24 microns in length (Figs. 13 F, G). Hairs on tarsi I relatively short, fBR 1.6–1.8, mBR 2.0–2.9, hBR 2.3–3.6. Pulvilli absent (Fig. 13 H).

Abdominal tergites with highly reduced numbers of hairs (Fig. 13 A). Hypopygium in Figs. 12 A, E. Ninth tergite with a pair of lobes produced caudally; with an incision in the middle, with about 12 short setae in a transverse row. Anal point absent. Gonocoxite short and thick, gonostylus very stout and almost parallel to the body axis such as in males of Chironominae. Inner lobe of gonocoxite long and finger-like, with about 10 short setae and numerous microtrichiae (Figs. 12 B, C). Gonocoxite with another low lobe on the inner side near the posterior end at the base of gonostylus, which bears several strong setae (Fig. 12 B). Appendages of gonostylus very unusual; terminal spur long, stout and with rounded apex, about 25 microns long and 5 microns wide; with 3 long terminal hairs 30, 20 and 17 microns long, respectively; a long and stout seta on the inner side at about middle, about 30 microns long; a group of some 7 setae on the inner side near the base; and a long tubercle bearing 1 or 2 long seta at the tip (Fig. 12 B, D).

Female. Female of the present species can be differentiated from that of related *Cricotopus* species by the body coloration similar to that of the male, i.e. ground color of scutum yellow, scutal stripes, scutellum and postnotum dark brown, legs with a broad pale ring only on front tibia, abdominal tergites I and II pale, III to VIII black, cerci white. Head in Fig. 11 D. Eyes highly pubescent, dorsomedial projection shorter than in male and ER larger than in male, 0.68–0.90. Supraorbital setae 7 or 8 on each side. Clypeal setae more numerous than in male, 24–28. Antenna with 5 flagellar segments, (135, 46, 50, 48, 128 microns), last segments expanded in the middle and with a long subterminal seta 63 microns in length (Fig. 11 A). Palp 4 segmented (24, 70, 80, 137 microns) Thorax in Fig. 11 E. Dorsomedian setae 16–22, all minute,

dorsolateral setae 15 or 16 on one side, supra-alar setae 3 or 4 on one side, scutellum with 10 or 12 setae. Wing as in Fig. 11 C and Table 2-8. Relative length of leg segments in Table 3-8. fLR 0.62–0.66, mLR 0.48–0.52, hLR 0.56–0.63. Cercus and spermathecae in Figs. 11 F, g.

Pupa. Length of abdomen 2.05–2.46 mm (2.31 mm in average of 8). Color of exuviae almost uniformly yellowish brown. Thoracic respiratory organs horn-like, length 159–202 (180 microns in average of 8 pairs), width 24–27 microns, with small spinules on the distal half (Fig. 14 A). Distribution of spines and spinules on abdominal segments in Fig. 14 B. Tergite II without proximal spinose areas (II-a, II-b absent), with a caudal zone of extremely small spines (2–3 microns in length; II-c), and a band of spines along the caudal margin (II-d), composed of 39–59 (47.7 in average of 9) large recurved spines (enlarged figure in Fig. 14 D); in addition, tergite II has a pair of spinulous areas in the proximolateral corners. Tergites III, IV and V with similar but somewhat differently shaped spinose or spinulous areas; a central spinose area (III-b, IV-b, V-b), a caudal spinose area (III-c, IV-c, V-c), a band of small (not so large as II-d) recurved spines in several rows (not in double rows as in II-d) on the intersegmental membrane, and a pair of lateral spinulous areas. Tergite VI with a central (VI-b) and a caudal spinose area (VI-c) but without a band of recurved spines on intersegmental membrane. Tergite VII with a central spinulous (not spinose) area, and a small spinose area in the middle near caudal margin (VII-c). Tergites VIII and IX with a basal spinulous area. The central spinose areas on tergites III and IV are much wider than long, while those on V and VI are almost circular (a distinguishing character of pupa of this species from that of related species, see Figs. 14 B, C, I). Sternites II and III with a large spinulous area continuous in the middle, while that on sternites IV to VII is interrupted in the middle and decrease in size by the order of the segment (Fig. 14 B). In addition, sternites IV, V and VI has a pair of whirl-like spinose areas in the caudolateral corners (Fig. 14 K), and sternites V to VII with a semioval spinulous area in the middle along the posterior margin (Fig. 14 B). Segments II to VI with 3 pairs, VII and VIII with 4 pairs of lateral hairs, all short and simple. Anal fins (Fig. 14 O) with 3 strong and curved caudal setae of subequal length, measuring 130–155 microns according to the specimens, or 140 microns in average of 7.

Discussion. This species is regarded as a typical member of the genus *Cricotopus* in reference to its key characters, such as the eyes being pubescent, and the dorsolateral setae of scutum being minute and arising from small pits. However, the structure of male hypopygium is quite unusual and can be easily differentiated from the previously known species of this genus by the shape and structure of gonostylus and its appendages, and by that of inner lobes of gonocoxite. Both male and female can be identified under a low-power magnification by the presence of a white ring on front tibia but not on all the other leg segments, and by the coloration of abdominal tergites (black excepting tergites I, II and hypopygium, which are pale or white). In pupa, this species can be differentiated by the characters of spinose areas on abdominal tergites, as shown in the key. Ecologically, it should be noted that adults and immature stages of this species was recovered only from the most oligotrophic parts of the river (Station No. 2 and 1) at the survey conducted during winter season.

(9) *Cricotopus tamapullus*, sp. nov.

Materials studied. Holotype: a male, emerged 27 December 1979 from a sample collected at Station No. 2 (A 56:71). Paratypes: a male, emerged 7 January (A 56:72); a female, emerged 27 December (A 56:74), all from Station No. 2.

Male. (descriptions based on two gum-chloral mounted specimens). Body length 2.72, 2.44 mm. Wing length 1.67, 1.56 mm. Body coloration largely dark brown or black; Ground color of scutum brown, scutal stripes black, leg segments almost uniformly brown (without pale rings), abdominal tergites II, III, V–VIII entirely black, IV largely brown and somewhat paler than other tergites, hypopygium white.

Head in Fig. 6 A. Antenna with 13 flagellar segments, AR 1.05 in the type specimen, last segment slightly expanded apically and with several short sensory setae (Fig. 16 B). Palp 4 segmented (46, 84, 94, 145 microns). Eyes highly pubescent, with a conspicuous dorsomedial projection, ER 0.91, 1.09. Supraorbital setae 5 or 7 on each side. Clypeal setae 12 or 10.

Anteprenotum bare dorsally, with 4 or 5 short lateral setae on each side. Setae on scutum and scutellum in Fig. 15 D; dorsomedian setae 15 or 14, roughly in two longitudinal rows; dorsolateral setae 27/25 or 23/23 on each side, roughly in two or three rows, all relatively short and arising from small pits; supra-alar setae 3/3 or 4/5 on each side. Scutellum with 20 setae in both specimens, roughly in two irregular rows (Fig. 15 D). Wing venation in Table 2-9 and Fig. 15 A. Wing membrane without macrotrichiae and with numerous minute microtrichiae, slightly purple when seen by transmitted light. Squama with 5 or 6 fringe setae. Anal lobe moderately produced. R 2+3 ending closer to tip of R 4+5 than to tip of R 1 (85%:93%:72%). fCu beyond r-m (54%/49%). An extending beyond fCu. Relative length of leg segments in Table 3-9. Values of fLR (0.55, 0.55) and mLR (0.45, 0.47) very small. Front tibia with a long and curved terminal spur (43 microns; Fig. 16 H); middle tibia with two short terminal spurs (24, 22 microns; Fig. 16 I); hind tibia with a long terminal spur (44 microns), a short terminal spur (18 microns), and a terminal comb composed of 12 free and simple spines (43–24 microns; Figs. 16 J, K); other leg segments without terminal spurs. Beards of tarsi I of medium length, fBR 2.2, mBR 2.3, hBR 2.6. Pulvilli absent, claws and empodium well developed (Fig. 16 C).

Hairs on abdominal tergites in Fig. 15 F; tergites II to VI with a basal and a distal transverse row of setae; tergites II to V with a single longitudinal row of setae on the median line, VI to VIII with double longitudinal median setae. Hypopygium in Figs. 16 F, G. Anal point absent, ninth tergite with an incision in the middle. Base of inner margin of gonocoxite simply U-shaped (a characteristic of subgenus *Cricotopus*, s. str.; Fig. 16 F). Inner lobe of gonocoxite composed of a single process with rounded margin, dorsally devoid of microtrichiae and with two setae (Fig. 16 D), ventrally with several short setae, and with some 10 strong setae along the basal margin (Fig. 16 E). Gonostylus slender, with a large and broad apical spur, and a semiglobular subapical lobe on the inner margin (Fig. 16 F).

Female (a single specimen mounted in gum-chloral). Body length 2.51 mm. Wing length 1.52 mm. Coloration as in male; scutum black, halteres yellow, scutellum and postnotum black, legs uniformly dark brown and without pale rings; abdominal tergites largely black, tergite IV brown and paler than the rest tergites, cerci white.

Head in Fig. 15 B. Antenna with 5 flagellar segments (75, 43, 42, 45, 92 microns), last segment with a subapical seta 44 microns long, and some 10 curved sensory setae

(Fig. 15 C). Palp 4 segmented (46, 77, 96, 135 microns). Eyes pubescent, without dorsomedian projection, ER 1.10. Supraorbital setae 6 on each side. Clypeal setae 15.

Anteprenotum with 4 lateral setae. Distribution of setae on scutum and scutellum in Fig. 15 E; dorsomedian setae 18 in two rows, dorsolateral setae 32 on each side and roughly in triple rows, all short (about 45 microns long) and arising from small pits; supra-alar setae 4 on each side. Scutum with 24 setae irregularly distributed. Wing venation in Fig. 15 A and Table 2-9. Squama with 5 fringe setae. Anal lobe rectangularly produced. R 2+3 ending closer to tip of R 4+5 than to tip of R 1. Costa slightly extending beyond tip of R 4+5 (96%:93%). fCu beyond r-m (50%:46%). Cu 2 almost straight. An reaching far beyond fCu. Relative length of leg segments in Table 3-9. fLR 0.54, mLR 0.47, hLR 0.55; fBR 1.5, mBR 1.6, hBR 1.6. Front tibia with a long spur (33 microns, shorter than that of male; Fig. 15 H), middle tibia with two short terminal spurs (22 and 19 microns; Fig. 15 I), hind tibia with a long terminal spur (51 microns), a short terminal spur (25 microns), and a terminal comb composed of 12 free spurs (46–25 microns; Figs. 15 J, K). Pulvilli absent (Fig. 15 G). Cercus in Fig. 15 M, 135 microns wide and 70 microns long. Spermathecae two, both dark brown, about 72 microns long and 58 microns wide (Fig. 15 L).

"Pupa of presumably *Cricotopus tamapullus*, sp. nov."

Altogether nine pupal exuviae were collected on 27 December from water surface of a rearing tube No. 2–19, and two adults (a male, holotype, and a female, paratype) of *Cricotopus tamapullus* were found on the same day in the same container. The pupal exuviae were identified as to comprise one *Orthocladus kanii*, one *Tanytarsus* sp. of a previously unrecorded species (adult missing), 6 *Orthocladus tamanitidis* (one accompanied larval skin), and one previously unrecorded species (No. 2 of A 56:76), which is treated here as of presumably this new species.

Length of abdomen 2.15 mm. Pupal skin almost colorless and remarkably paler than those of coexisting other species. Thoracic respiratory organs horn-like, one 142 microns long and 19 microns wide, another 146 microns long and 20 microns wide, both with rather pointed apex and with only a few small spinules on the surface (Fig. 17 A). Cephalothorax with a pair of semiglobular tubercles (55 microns in diameter) bearing three very long hairs near bases of thoracic respiratory organs (Fig. 17 B). Distribution of spines and spinules on abdominal segments in Fig. 17 A. Tergite II without spinose or spinulose areas (II-b, II-c absent), and with 56 large recurved spines (about 25 microns long) in two transverse rows along the caudal margin (Fig. 17 D). Tergites III, IV and V with a middle spinose area (-b), a distal spinose area (-c), and a caudal band of small recurved spines in multiple rows on the intersegmental membrane (-d; Fig. 17 E). Tergite VI with a middle (VI-b) and a distal (VI-c) spinose area, but recurved spines are absent from the intersegmental membrane (Fig. 17 E). Middle (-b) and distal (-c) spinose areas on tergites III to VI are clearly separated from each other (these are continuous in pupae of genus *Orthocladus* described in the present paper). In addition, tergites III, IV and V with a pair of spinulose areas in the lateral and proximal parts, and V and VI with a pair of spinulose areas in the caudolateral corners. Tergites VII, VIII and IX each with a spinulose area in the proximal part. Sternites IV, V and VI with a pair of whirl-like spinose areas (-w) in the caudolateral corners (Figs. 17 C, G). Sternites III to VIII each with spinulose areas (Fig. 17 C). Segments II to VII with 3 pairs, and segment VIII with 4 pairs of lateral hairs, all relatively short and simple. Anal segment with a pair of sack-like anal fins bearing three terminal setae each about 115 microns long and 8 microns thick at the base (these hairs are significantly thicker than those of related species; (Fig. 17 H).

Discussion. This species is considered as to belong to subgenus *Cricotopus* s. str. in the sense of Hirvenoja(1973), since eyes are pubescent, dorsolateral setae of scutum are all minute and arising from small pits, and basal part of inner margin of gonocoxite is simply U-shaped, and hypopygium is white. Among the species groups defined by the same author (p. 136), the present species seems to be most closely related to the *cylindraceus*-group, because setae on abdominal tergites are reduced in numbers and those on tergites II to VI form basal and distal transverse rows, and inner lobes of gonocoxite is simple (not double as in *tremulus*-group). However, the present species differs from the three European species of this group in that tergites II to V with a single median row and VI to VIII with double median rows of setae (Fig. 15 E), with a pale area only on tergite IV, and without pale rings on any of the leg segments. The present species can also be differentiated from previously known species of this genus in Japan in the above body coloration, in the numbers and arrangements of dorsolateral setae on scutum, in the chaetotaxy of abdominal tergites, and in the peculiar structure of inner lobes of gonocoxite.

(10) *Rheocricotopus tamahumeralis*, sp. nov.

Materials studied. A total of 10 males, 4 females and 12 pupae or pupal exuviae were recovered during 2 to 14 January 1980, from bottom sediments collected at Station No. 2 of Minamiasakawa River (this species was not found among specimens emerged before 2 January, nor among those collected in the other stations). Holotype: a male (No. A 56:01), dissected from dead pupa collected on 2 January 1980. Paratypes: 6 males (A 56:02-07) and 3 females (A 56:11-13), mounted in gum-chloral; a male and a female, fixed on pin.

Male. Body length 2.7–3.3 mm. Wing length 1.69–2.08 mm. Body coloration almost entirely black (body) or dark brown (legs), though halteres are slightly paler, and the pair of large humeral pits are devoid of pigments.

Head in Fig. 19 A. Antenna with 13 flagellar segments, AR 1.10–1.28 (1.18 in average of 6). Tip of antenna slightly expanded and with several sensory setae (Fig. 19 B). Palp 4 segmented (60, 92, 106, 186 microns in the type specimen). Eyes highly pubescent, almost reniform and without dorsolateral projection, ER 0.81–0.96 (0.88 in average of 6). Supraorbital hairs 3–5, clypeal hairs 9–12.

Thorax as in Fig. 18 D. Anteprepronotum bare dorsally, with 4 short lateral hairs in the type specimen. Scutum with a large colorless humeral pits (hmp) 125 microns long and 75 microns wide on both sides. Dorsomedian setae 22–32, minute (about 8 microns long) and arising from small pits. Dorsolateral setae 11–14 on each sides, about 30 microns long and all arising from large pits. Prealar setae 3 or 4 on both sides. Scutellum with 4–6 setae in a transverse row. Wing membrane bare, slightly brown under transmitted light. Wing venation in Fig. 18 A and Table 2-10. Squama with 2–4 setae. Anal lobe rather flat. R 2+3 clearly separated from R 1 and R 4+5, ending closer to tip of R 1 than to that of R 4+5. fCu slightly beyond r-m. Costa extending beyond end of R 4+5, which is slightly proximal to the end of the vein M. An extending beyond fCu. Relative length of leg segments in Table 3-10. LR 0.69–0.75 in front, 0.48–0.52 in middle, and 0.55–0.61 in hind leg. Front tibia with a long terminal spur about 44 microns long (Fig. 19 C), middle tibia with two short terminal spurs about 15 and 20 microns long (Fig. 19 D), hind tibia with a long terminal spur 42 microns long, a short terminal spur 15 microns long, and about 12 terminal comb spurs 32–24–32

microns long (Figs. 19 E, F). Hairs on tarsi I medium in length, fBR 1.7–2.7, mBR 2.2–2.8, hBR 2.9–4.0. All legs with a pair of large pulvilli (a distinguishing character of this species; Fig. 19 G).

Hairs on abdominal tergites not much reduced in numbers such as in some *Cricotopus* species and fairly evenly distributed (Fig. 18 F). Hypopygium in Figs. 19 H, I. Third clasper (Dritte Spange of Lehmann, 1969, p. 349) with a tooth-like process (tc of Fig. 19 I). Anal point triangular in dorsal view and apically pointed, with about 5 lateral setae on both sides. Inner lobe of gonocoxite single, roughly rectangular and with a broad base, and bear a claw-like process at the tip (Fig. 19 H, J). Gonostylus widest at about middle and without preapical tooth (Fig. 19 H).

Female (measurements of 3 mounted specimens). Body length 2.36, 2.66, 3.33 mm, wing length 1.97, 2.03, 2.05 mm. Body coloration almost entirely black (abdomen and legs slightly brownish), humeral pits large and colorless. Head in Fig. 18 B. Antenna with 5 flagellar segments (89, 60, 67, 65, 113 microns long; Fig. 18 C). Palp 4 segmented (68, 116, 159, 268 microns). Eyes reniform, highly pubescent, ER 0.84, 0.88, 0.95. Supraorbital setae 2 or 3 on each side. Clypeal setae 14 or 16. Thorax in Fig. 18 E. Anteprenotum bare dorsally, with about 7 weak lateral setae on each side. Dorsomedian setae 30–36, dorsolateral setae 16–20 on each side, supra-alar setae 3, 4 5 on each side. Scutum with a pair of large colorless humeral pits. Scutellum with 6 setae in a transverse row. Wing membrane bare, strongly tinted with brownish or purplish color. Wing venation in Fig. 18 A and Table 2-10. Anal lobe rather flat. Relative length of leg segments in Table 3-10. fLR 0.73–0.74, mLR 0.49–0.51, hLR 0.56–0.58. fBR 1.4–2.1, mBR 1.7–1.8, hBR 1.7–2.2. Cercus and spermathecae in Figs. 18 G, H.

Pupa. Length of abdomen 1.92–2.36 mm (2.24 mm in average of 6). Thoracic respiratory organs horn-like, widest at about apical 1/3 and with rounded apex, length 262–330 microns (299 microns in average of 8 pairs), with numerous small spines on entire surface (Fig. 20 A). Distribution of spines, spinules and hairs on abdominal tergites in Fig. 20 B. Tergite II with a posteriorly convex lens-shaped spinose area near the posterior margin, and a pair of small spinulous areas in the anterolateral corners. Tergites III to VI each with an almost circular spinose area in the center (that on tergite III is rather ill defined), narrow and wide lens-shaped spinose area along the posterior margin, and rather sparse spinulous areas connecting the two spinose areas and in the anterolateral corners. Tergites VII and VIII each without spinose areas and with a central and a caudal spinulous areas. Tergite IX with spinulous areas in the middle and in the anterolateral corners. Sternites IV, V and VI each with a pair of spinose areas in the caudolateral corners (not whirl-like as in most other species). The number of lateral hairs are 2 pairs on abdominal segment I, 3 pairs on II to IV, 4 pairs on V to VII, and 5 pairs on VIII. Lateral hairs on segments VII and VIII are long and filamentous (Fig. 20 F). Anal fins are fringed with 10–12 filamentous hairs (most commonly 10), and with 3 long and filamentous (not rigid as in most other Orthocladinae pupae) caudal hairs (Fig. 20 F).

Discussion. This species is a typical member of the genus *Rheocricotopus* Thienemann et Harnisch, 1933, in reference to the adult characters defined by Brundin (1956) or Lehmann (1969). In the adult male, this species is characteristic in that the eyes are pubescent and without conspicuous dorsomedial projection. AR slightly larger than 1, scutum shining black and with large colorless humeral pits, dorsomedian setae very short and numerous, dorsolateral setae arising from large pale pits, wing membrane bare, Cu 2 almost straight, legs with large pulvilli, male hypopygium with a large triangular

anal point bearing about 10 lateral hairs, and gonostylus not abruptly curved and without preapical tooth. Among the *Rheocricotopus* species reviewed by Lehmann (1969), the present species belongs to the group with tooth-like third clasper (Dritte Spange zahnformig); of the two known species in this group, the present species differs from *effusus* Walker in that anal lobe of wing is rather reduced and the preapical tooth of gonostylus is absent; from *nepalensis* Lehmann it differs in the shape of anal lobe (more reduced in *nepalensis*) and of humeral pits (circular in *nepalensis*, ovoid in the present species; the present species differs also from both in the structure of inner lobe of gonocoxite, which carry a tooth-like process in the present species.

A species of *Rheocricotopus* was recorded from Kyoto, Japan by Tokunaga (1938, p. 319) by the name of *Spaniotoma* (*Trichocladius*) *chalybeata* Edwards, but the present species differs from it in the shape of gonostylus (abruptly curved in *chalybeata*) and of third clasper (broad and rectangular in *chalybeata*).

In the pupa, the present species seems to belong to the *fuscipes* group of genus *Rheocricotopus* in reference to the key prepared by Thienemann (1944, p. 592), in that it has 3 long terminal hairs and some 10 filamentous lateral hairs on anal fins, bands of strong spines along the caudal margins of abdominal tergites II to VI, and a pair of long, horn-like thoracic respiratory organs.

(11) *Microcricotopus tamabicolor* (Sasa, 1981)

A male (No. A 54:25) recovered from a sample of Station No. 6 on 25 December 1979 and a female (No. A 54:26) from Station No. 4 on 25 December 1979 were identified as *Microcricotopus tamabicolor* described in the previous paper with specimens collected at the summer survey of the same river.

(12) *Paratrachocladius tamaater* (Sasa, 1981)

Two males were recovered 25 December from a sample collected at Station No. 2, and were identified as belonging to the above species described in the previous paper with specimens collected at the summer survey. (No. A 53:09).

(13) *Eukiefferiella*, sp.

Two males, one female and two pupal exuviae were recovered from samples collected at Station No. 2. Morphologically the male and pupa are different from *E. tamabiflavus*, Sasa, 1981, described in the previous paper, but its taxonomical status will be reported later when more materials become available.

(14) *Parakiefferiella tamatriangulatus*, sp. nov.

Materials studied. A total of 4 males, 6 females and 2 pupal exuviae were recovered from samples collected 12 December 1979 at Nos. 2 and 3 Stations of Minami-asakawa. Holotype: male, emerged on 25 December at No. 3, dissected and mounted

in gum-chloral (No. A 56:81). Paratypes: a male from Station No. 3 and 2 males from No. 2 (Nos. A 56:82–84), 4 females from No. 3 and a female from No. 2 (Nos. A 56:86–90); a female from No. 2 fixed on pin. Two pupal exuviae associated with females from No. 2 and mounted in gum-chloral (Nos. A 56:91, 92).

Male. Very small midge with the body length of 1.62–1.90 mm (1.65 mm in average of 4), and wing length of 1.05–1.18 mm (1.12 mm in 4). Ground color of scutum yellow, scutal stripes reddish brown, scutellum yellow, postnotum brown, halteres yellow, leg segments almost uniformly brown, abdominal tergites and hypopygium brown.

Head in Fig. 21 B. Antenna with 13 flagellar segments, last segment slightly expanded near apex and with some 20 curved sensory setae (Fig. 22 C), AR very small, 0.38–0.48 (0.43 in average of 4). Palp 4 segmented (27, 51, 48, 87 microns). Eyes bare, reniform and without dorsomedial projection, ER 1.27–1.47 (1.38 in average of 4). Supraorbital setae only 2, 3 or 4. Clypeal setae only 4, 5 or 6.

Anteprepronotum with only 1 or 2 lateral setae. Scutum without dorsomedian setae, with a peculiar spine-group just behind median stripes (Fig. 22 B), with 4 or 5 pairs of dorsolateral setae all arising from small pits (not from large white pits), and 3 supra-alar setae on both sides (Fig. 22 A). Scutellum with only 2 or 4 setae. Wing venation in Table 2-14 and Fig. 21 A. Wing membrane without macrotrichiae, slightly brown, very finely granulated. Anal lobe rather flat. Squama without fringe setae. R 2+3 separated from both R 1 and R 4+5, ending closer to end of R 4+5 than to end of R 1. Costa extending much beyond tip of R 4+5 (95%:89%). fCu beyond r-m (50%:46%). Cu 2 conspicuously sinuate. An reaching beyond fCu. Relative length of leg segments in Table 3-14. fLR 0.52–0.54; mLR 0.43–0.47; hLR 0.52–0.57. Front tibia with a long terminal spur (30 microns; Fig. 22 C), middle tibia with two short terminal spurs (10, 12 microns; Fig. 22 D), hind tibia with a long terminal spur (26 microns), a short terminal spur (13 microns), and a terminal comb composed of 12 free spurs (15–26 microns; Figs. 22 E, F). Tarsi of all legs without terminal spurs. Beards on tarsi relatively long, fBR 2.0–2.7; mBR 3.2–3.4; hBR 3.0–5.3. Claws and empodium well developed, pulvilli absent (Fig. 22 G).

Abdominal tergites with highly reduced numbers of hairs, which are arranged into a relatively regular geometrical pattern, the central, the intermediate, and the lateral rows (Fig. 21 D). Hypopygium in Figs. 22 H, I. Anal point broadly triangular with 3 or 5 lateral setae (Fig. 22 J). Inner lobe of gonocoxite roughly rectangular but apically rounded, with some 12 strong setae along the posterior and inner margins (Fig. 22 K). Gonostylus in Fig. 22 K.

Femal. Distinguished from other coexisting Orthoclaadiinae females by body coloration, by the presence of peculiar spine groups on scutum (Figs. 21 G, H), and by sinuated wing vein Cu 2 (Fig. 21 A). Body length 1.28–1.44 mm, wing length 1.12–1.28 mm. Coloration as in male; ground color of scutum and scutellum yellow, scutal stripes reddish brown, postnotum brown, legs brown, abdominal tergites dark brown.

Head in Fig. 21 E. Antenna with 5 flagellar segments (38, 24, 29, 31, 84 microns), last segment with some 10 sensory setae (Fig. 21 F). Palp 4 segmented (26, 48, 51, 82 microns). Eyes reniform, ER 1.35–1.54. Supraorbital setae 3 or 4 on each side, absent on vertex between eyes. Clypeal setae 4, 5 or 6.

Scutum without dorsomedian setae, with a peculiar spine group in the center just behind median stripes like in male (Figs. 21 G, H), with 5, 6 or 7 dorsolateral setae

all arising from small pits, and with 3 prealar setae on each side (Fig. 21 G). Scutellum with 2, 4 or 6 setae. Wing venation in Table 2-14 and Fig. 21 A. Squama bare. Anal lobe rather flat. R 2+3 separated from R 1 and R 4+5, ending closer to tip of R 4+5. Cu 2 sinuate. fCu beyond r-m (47%:42%). An reaching far beyond fCu. Relative length of leg segments in Table 2-14; fLR 0.53–0.54; mLR 0.45–0.46; hLR 0.51–0.54. fBR 2.1–2.3; mBR 2.7–3.4; hBR 4.3–5.3. Cercus long, ear-like (Fig. 21 J). Spermathecae dark brown, almost globular (Fig. 21 I).

Pupa. (Description based on 2 femae pupal exuviae). Length of abdomen 1.44 and 1.45 mm. Color of exuviae slightly brown, (paler than in related species). Thoracic respiratory organs (Fig. 23 E) egg-shaped, (length x width : 87x51, 84x60; 91x60, 84x65 microns), with numerous small spines on the apical part. Distribution of spines and spinules on abdominal tergites in Fig. 23 A. Segment I without spines and spinules. Tergite II with a pair of proximal spinose areas (II-a; spines are all very small), a transverse band of small spines along the caudal margin (II-c), and a band of about 60 small recurved spines in roughly triple rows on the intersegmental membrane (II-d, Fig. 23 B). Distribution of spines on tergite III is similar to that of II, but the spines on III-a are larger than those of II-a. Tergites IV with a pair of proximal spinose areas (IV-a), a central spinose area composed of larger spines (IV-b), a caudal band of spines (IV-c), and a transverse band of small recurved spines on the intersegmental membrane (IV-d; Fig. 23 B). Tergite V is similar to IV, but without spines on intersegmental membrane. Tergite VI with a pair of proximal spinose areas (VI-a), and a pair of caudal spinose areas (VI-c). Tergites VII and VIII without spines and spinules. Sternites II to VIII all with spinulous areas in the central or proximal part. Lateral setae are 1 pair on segment I, and 4 pairs on segments II to VIII, all simple and relatively short, excepting the first pair on segments VII and VIII, which are slightly flattened (Fig. 23 C). Anal fins roughly conical, with sharply pointed apex, and bear 3 stout and curved setae arising from apical 1/3 of each fin (Fig. 23 D).

Discussion. This species is considered as a member of the genus *Parakiefferiella* Thienemann, 1936, in view of the adult characters defined by Brundin (1956, p. 148) and Pinder (1978, p. 50). Especially characteristic is the wing venation, i.e. Cu 2 strongly sinuate, costa extending beyond tip of R 4+5, which is proximal to end of Cu 1, R 2+3 close and almost parallel to R 4+5, An extending beyond fCu. The characters of eyes and antennae, the absence of dorsomedian setae, the small numbers of dorsolateral setae and supra-alar setae on scutum, the absence of pulvilli, and the structure of anal point and inner lobe of gonocoxite are also characteristic to this genus.

Among the known species of this genus, the present one seems to be closest in the structure of adult male to *P. bathophila* (Kieffer) of Brundin (1956, p. 152) and Pinder (1978, Fig. 33 C), or to *Smittia cheethami* of Edwards (1929, p. 359), which is a synonym of *P. bathophila* according to Pinder (1978). However, the present species differs from *P. bathophila* in the structure of anal point (narrower and more pointed, bare dorsally in the present species), in the shape of inner lobe of gonocoxite (broader and more rounded), in the value of AR (0.6 or 0.8 in *bathophila*), and in body coloration (paler in the present species). Especially characteristic to this species is the presence of a peculiar spine-group on scutum just behind median stripes both in male and female (Figs. 21, G, H, 22 A, B). The structure of pupa of the present species also fits well with that of *Parakiefferiella* s. str. of Brundin (1956, p. 153), and is apparently closest also to the pupa of *P. bathophila* in the shape of thoracic respiratory organs,

the distribution of spines on abdominal tergites, and in the structure of anal fins bearing 3 strong setae. However, both differ in the distribution of spinules on the thoracic respiratory organs (in *bathophila*, the spinules cover the distal half), and in the relative length of the tail part of anal fins and the anal bristles (in *bathophila*, the anal bristles exceed the tip of anal fins at least half its length, while they only slightly exceed the tip in the present species, see Fig. 23 D).

(15) *Brillia japonica*, (Tokunaga, 1939)

Three males and three females of this species, together with pupal exuviae, were recovered from Station No. 2 and 3 at the winter survey, indicating again that this is a species which prefer clean waters for the larval growth. Morphological accounts were given in the previous paper with specimens collected at the summer survey of the same river.

(16) *Limnophyes tamakitanoides*, sp. nov.

Materials studied. Holotype: a male (A 56:41), emerged on 20 December 1979 from a sample collected at Station No. 6 (the most polluted part of Minamiasakawa River), 12 December. Paratype: a female, same data, both dissected and mounted in gum-chloral (A 56:42).

Male. Body length 2.67 mm. Wing length 1.62 mm. Body coloration, almost uniformly dark brown, excepting halteres, coxae and trochanters which are paler, and eyes and tibial combs, which are darker.

Head in Fig. 25 A. Antenna with 13 flagellar segments, AR 0.80, last segment not apically expanded, with two stout knife-like spurs and 4 short and curved sensory setae at near apex, and the usual flagellar setae to near apical end (Fig. 25 B; a characteristic of this genus; in most other species the flagellar setae are absent from apical part of the last segment). Palpi 4 segmented (36, 85, 87, 145 microns). Eyes bare, reniform, without dorsomedial projection, 300 microns apart from each other and 205 microns high, ER 1.46. With a pair of short setae above antennal base, and 3 setae on each side above the eyes. Clypeus with 21 setae.

Anteprepronotum with a pair of long setae in the dorsal part, and 3 or 4 lateral setae (Fig. 25 C). Setae on scutum in Fig. 25 D. Scutum almost uniformly black and scutal stripes are hardly distinguishable. Dorsomedian setae 10, all minute and simple, anterior part of midline of scutum is bare and dorsomedian setae are situated between 25% and 50% of the midline. Dorsolateral setae of scutum, which are most characteristic to this species, are composed of 13 long and simple setae (about 160 microns long) arising from large pale pits in the anterior 2/3 of scutum, and 17 short, leaf-like setae (about 20 microns long and 6 microns wide) arising from smaller pits in the posterior 1/3 of scutum (Fig. 25 E). Supra-alar setae 6 on each side. Scutellum with 8 setae in a transverse row. Wing venation in Fig. 24 A and Table 2-16. Wing membrane without macrotrichiae but with numerous conspicuous microtrichiae all about 1 micron long. Squama with 4 fringe setae. Anal lobe rather flat. R 2+3 separated from R 1 and R 4+5. Costa extending beyond end of R 4+5 (67% and 64% of wing length). fCu much beyond r-m (38% and 32%). Cu 2 strongly sinuate. Relative length of leg segments in Table 3-16.

FLR 0.55, mLR 0.54, hLR 0.53; fBR 0.9, mBR 2.3, hBR 2.7. Front tibia with a long terminal spur (51 microns; Fig. 25 F), middle tibia with two short terminal spurs (29 and 31 microns; Fig. 25 G), hind tibia with a long terminal spur (56 microns), a short terminal spur (25 microns), and a terminal comb composed of 12 spurs 17–51 microns in length (Figs. 25 H, I). Glaws and empodium in Fig. 25 J, pulvilli absent.

Distribution of hairs on abdominal tergites in Fig. 25 K. Hypopygium in Figs. 26 A, E. Anal point absent, ninth tergite with two small posterior lobes bearing several setae (Fig. 26 B). Inner lobe of gonocoxite with rounded margin (Figs. 26 A, C). Gonostylus in Fig. 26 D.

Female. Body length 2.16 mm. Wing length 1.35 mm. Coloration as in male, body largely black or dark brown. Head in Fig. 24 B. Antenna with 5 flagellar segments, (53, 41, 60, 63, 104 microns), segment I shorter than segment III and IV; last segment with a terminal setae 70 microns long (Fig. 24 C). Palp 4 segmented (36, 72, 74, 154 microns). Eyes bare, reniform, ER 1.22. Supraorbital setae 4 on each side. Clypeal setae 20.

Anteprenotum well developed, with 8 strong setae dorsally on each side, and 5 lateral setae on each side (Fig. 24 D; cf. only 1 dorsal seta in male; Fig. 25 C). Scutum with 8 minute dorsomedian setae in the middle part (no dorsomedian setae in the anterior part, as in male); with two kinds of dorsolateral setae, i.e. 19 strong and simple setae in the anterior 2/3, and 12 or 14 short and leaf-like setae in the posterior 1/3 (Figs. 24 E, F); and with 7 supra-alar setae on each side. Scutellum with 8 setae in a transverse row (Fig. 24 E). Wing venation as in Table 2-16 and Fig. 24 A. Squama with only 2 setae. R 2+3 separated from both R 1 and R 4+5. Costa extending much beyond end of R 4+5 (67%/63%). fCu much beyond r-m (37%/32%). Cu 2 strongly sinuate. An ending under fCu. Wing membrane with numerous minute microtrichiae. Relative length of leg segments in Table 3-16; fLR 0.55, mLR 0.54, hLR 0.54. Front tibia with a long terminal spur (34 microns; Fig. 24 G), middle tibia with two short terminal spurs (29 microns and 27 microns; Fig. 24 H), hind tibia with a long terminal spur (53 microns), a short terminal spur (23 microns), and a terminal comb composed of 12 free spurs (26–44 microns; Fig. 24 I). Pulvilli absent, claws and empodium well developed (Fig. 24 J). Cercus in Fig. 24 L. Spermathecae dark brown, roughly egg shaped, 84x62 microns and 92x40 microns (Fig. 24 K).

Discussion. This species is considered as a member of the genus *Limnophyes* Eaton as redefined by Brundin (1956, p. 131), since eyes are bare and not extended dorsomedially, wing membrane is thickly covered with microtrichiae, costa extending beyond end of R 4+5, Cu 2 is strongly sinuate, squama with only a few setae, and scutum bears leaf-like or lamellar dorsolateral setae. Species of this genus are mostly terrestrial in their larval habitats, but this species was reared from a bottom sample collected at the most polluted part of the river (Station No. 6). Among species of this genus known from Europe, the present one seems to be closest to *L. truncorum* (Goetghebuer), in the shape and distribution of the lamellar setae on scutum, but differs from it essentially in the shape of inner lobe of gonocoxite (narrow and pointed apically in *truncorum*), and in the structure of gonostylus (apically pointed and with a long, slender subapical spine). Two species of *Limnophyes* were recorded by Tokunaga (1940, 1965), *L. fuscipygma* (Tokunaga, 1940) from Taiwan, and *L. prolongatus*, Kieffer 1921 from Kyoto, but the present species differs essentially from them in the shape and distribu-

tion of the lamellar setae, in the shape and structure of inner lobes of gonocoxite, and in the structure of gonostylus. The present species also differs from the characters described by Brundin (1956) as being common to this genus in such points as the presence of a pair of setae on vertex between eyes, and the presence of numerous strong setae on dorsal part of anteprenotum in the female.

(17) *Parametriocnemus stylatus* (Kieffer, 1924)

A male and 3 females from samples of Station No. 3, and a male and a female from Station No. 4, were examined and identified as being the same species as described by Sasa (1981) under the above name in the previous paper.

(18) *Chironomus yoshimatsui* (Martin et Sublette, 1972)

A total of 50 males and 51 females were recovered again from the most polluted parts of the river, Stations Nos. 6, 5 and 4.

(19) *Dicrotendipes tamaviridis*, sp. nov.

Materials studied. A male, emerged on 25 December 1979 from a sample collected at Station No. 4 of Minamiasakawa River on 12 December, dissected and mounted in gum-chloral (A 46:91). A pupal skin associated with the male and mounted in gum-chloral (a 46:92).

Male. Body length 3.69 mm. Wing length 2.09 mm. Color largely yellowish green, scutal stripes reddish brown, scutellum yellow, postnotum yellowish brown, halteres yellow, leg segments brownish yellow, terminal combs of middle and hind tibiae dark brown, abdominal tergites yellowish green.

Head in Fig. 28 A. Antenna 1.20 mm long, with 11 flagellar segments, AR 2.47, terminal segment with 8 sensory setae (Fig. 28 B). Palp 4 segmented (48, 145, 150, 275 microns). Eyes bare, with long and narrow dorsomedial projection, ER 0.21. With a pair of small frontal tubercles, 8 microns long and 4 microns in diameter. Supraorbital hairs 20 on each side. Clypeal hairs 20.

Scutum with 16 dorsomedian setae, 8 dorsolateral setae on each side, and 3 supraalar setae on each side. Scutellum with 9 setae in a transverse row. Wing in Fig. 27 L and Table 2-19. Squama with only 2 or 3 setae. Anal lobe relatively flat. Wing membrane colorless and bare. R 2+3 separated from both R 1 and R 4+5, running close to R 1. Costa not extending beyond tip of R 4+5. fCu much beyond r-m. Relative length of leg segments in Table 3-19. fLR 1.82, mLR 0.53, hLR 0.61. Front tibia with 3 long subterminal setae (190, 161, 159 microns), and a terminal scale with rounded margin (Fig. 27 I). Middle and hind tibiae with two terminal comb scales, both bearing a long spur (Figs. 27 J, K). fBR 2.2, mBR 3.0, hBR 4.4. All legs with well developed pulvilli, empodium and claws (Fig. 27 H).

Hypopygium in Figs. 27 A, B. Anal point strongly curved ventrad and apically rounded, with several setae near the base (Fig. 27 C). Dorsal appendage apically expanded and with rounded caudal margin, with 5 strong and orally directed setae on

the inner margin, and with microtrichiae on the ventral side and along the inner margin (Figs. 27 E, G). Ventral appendage extremely long and slender, strongly curved and apically expanded like a bulb, with 9 strong and orally directed setae on the dorsal side of the apical bulb, a relatively short apical seta directed caudally (20 microns) and 7 shorter and thinner setae arising from inner margin of the bulb (Figs. 27 F, G). Gonostylus slender and curved medially, with 7 short subapical setae along the inner margin (Fig. 27 A, D).

Pupa. Length of abdomen 3.25 mm. Pupal skin almost colorless. Thoracic respiratory organs divided into numerous filaments (a *Chironomus*-type). Distribution of spines and spinules on abdominal tergites in Fig. 28 C. Tergite II with a large central spinose area covering nearly the entire surface (II-a, -b, -c), each spine being very small, and a single transverse row of relatively short recurved spines (98 in number, each about 15 microns in length; Fig. 28 D). Tergites III, IV and V with also a large central spinose area covering almost the entire surface, and a caudal spinose area bearing extremely small spines in tergite III (Fig. 28 E), or narrow and sharply pointed spines in tergites IV and V (Figs. 28 F, G). Tergite VI with a pair of proximal spinose areas (VI-a), a central spinose area (VI-b), and a pair of caudal spinose areas (VI-c). Tergite VII with one pair of spinulose areas. Tergite VIII with two pairs of spinulose areas. Segments II to IV with 3 pairs of short and simple lateral hairs, segments V to VIII with 4 pairs of long, flat and filamentous lateral hairs. Anal fins each fringed with 38 long, filamentous lateral hairs. Segment VIII with a pair of long and sharply pointed, simple caudolateral scales (Fig. 28 L). Sternites IV and V with a pair of spinose areas in the caudolateral corners (Figs. 28 J, K), whereby the arrangements of spines are whirl-like in IV but all directed lateral in V.

Discussion. This species is considered as being a typical member of genus *Dicrotendipes* (*Limnochironomus* of various authors, or group C of subgenus *Chironomus* of Edwards, 1929), because ventral appendages are long and narrow, and bear long setae only near the tip; other characters are largely in common with genus *Chironomus* in the strict sense. Among the known species of this genus, the present species seems to be closest to *Dicrotendipes* (= *Limnochironomus*) *lobiger* (Kieffer) in body coloration and in that ventral appendages are shorter and less curved than in most other species of this group. However, the present species differs from *lobiger* in the structure of dorsal appendages (in *lobiger*, they are not sinuate like in the present species, and has a beak-like process, which is lacking in the present species). The presence of frontal tubercles in the present species is probably an unusual character as a member of this genus (Edwards, 1929, p. 386, states "no frontal tubercles" for *Limnochironomus*). The present species is also similar to *D. tritonus* (Kieffer) in the shape of dorsal appendage and gonostylus, but differs from it in the structure of ventral appendage (that of *tritonus* is bilobed apically). Freeman (1956) described 19 species of *Dicrotendipes*. According to Sublette and Sublette (1973), a total of 9 species of this genus were recorded from the Oriental region. Towns (1945) described 10 species of *Limnochironomus* from the Nearctic Region. The present species seems to be different from all these previously described species of this genus.

(20) *Polypedilum (Polypedilum) kobotokense*, sp. nov.

Materials studied. Holotype: male (A 46:51), emerged 7 January 1980, from a sample collected at Station No. 2 of Minamiasakawa River, dissected and mounted in gum-chloral. Paratypes: a male (A 46:52), same data; two females (A 46:53, 54), emerged 7 and 10 January, from the same samples, mounted in gum-chloral; a female, emerged on 7 January and fixed on pin. Three pupal exuviae (two males and one female) associated with the adults were mounted in gum-chloral (No. A 46:57, 58, 59).

Male. Body length 3.72, 3.56 mm, wing length 2.23, 2.18 mm. Body coloration almost uniformly pale yellow excepting eyes, which are dark brown, even the areas of scutal stripes are pale yellow and indistinguishable from ground color of scutum; legs uniformly yellow, excepting tibial combs, which are dark brown.

Head in Fig. 29 D. Antennal flagellum 13 segmented, AR 1.31 and 1.57, last segment with 3 long subapical setae and 4 curved sensory setae (Fig. 29 E). Palpi 4 segmented (53, 161, 140, 227 microns). Eyes with a long dorsomedial projection, ER 0.44, 0.32. Supraorbital setae 8 or 10 on one side. Clypeal setae 18, 16.

Scutum with 22 or 18 dorsomedian setae, 22 and 21, or 18 and 16 dorsolateral setae, and 5 or 6 supra-alar setae on one side. Scutellum with 24 or 18 setae in two rows. Wing in Fig. 29 A and Table 2-20. Wing membrane bare, colorless and unmarked. Squama with about 10 setae. R 2+3 running close to R 1 but clearly separated near the tip. fCu much beyond r-m. Relative length of leg segments in Table 3-20. Femora and tibiae with long hairs. fLR 1.98, 1.62; mLR 0.58, 0.61; hLR 0.75, 0.76. Tarsi with relatively long hairs, fBR 2.5, 2.9; mBR 4.2, 5.0; hBR 4.5, 6.0. Pulvilli well developed (Fig. 29 H). Front tibia with a rounded terminal scale (Fig. 29 F). Middle and hind tibiae with two terminal combs, one with a long spur, the other without spur (Fig. 29 G).

Abdominal tergites without markings; and with long setae. Tergite VIII constricted basally (a characteristic of genus *Polypedilum*). Hypopygium in Figs. 30 A, B. Anal point long, slender, parallel-sided and bare (Fig. 30 C). Anal tergite with a group of some 16 long but unpigmented setae in the middle, 4-7 shorter setae on the posterior margin on either side of anal point (Fig. 30 A), and 7-10 short setae (about 12 microns long) on the ventral side near the posterior margin and on both sides of anal point (Fig. 30 D). Dorsal appendage horn-like, about 100 microns long and almost straight excepting the apical part which is strongly curved, with a long seta (90 microns) on the dorsal side and two shorter setae (about 50 microns) on the ventral side but devoid of microtrichiae (Fig. 30 E). Ventral appendage (Fig. 30 F) long and slender (190 microns long and 30 microns wide in the middle), not apically expanded, with some 12 strong and recurved setae on the apical half of dorsal surface, and a long apical seta (100 microns) reaching beyond tip of gonostylus. Gonostylus long and stout (170 microns long and 50 microns wide in the middle), with a row of 4-6 long setae along the apical half of inner margin, an apical and two subapical setae, and a row of some 10 setae on the ventral side (Figs. 30 B, G).

Female. (Description based on 2 gum-chloral mounted and 1 dry preserved specimens). Body length 3.72, 2.71 mm. Wing length 2.39, 2.29, 2.29 mm. Body coloration as in male, eyes and tibial combs dark brown, otherwise almost uniformly pale yellow, scutal stripes yellow and almost indistinguishable from ground color of scutum. Head in Fig. 29 B. Eyes with a wide dorsomedial projection, ER 0.49, 0.47. Supraorbital setae 10 or 8 on each side, clypeal setae 16 or 18. Antenna with 5 flagellar

segments, (123, 90, 89, 63, 166 microns), the last segment with some 10 curved sensory setae and 3 long subapical setae (186, 171, 164 microns; Fig. 21 C). Palp 4 segmented (43, 135, 120, 174 microns). Dorsomedian setae of scutum 21, dorsolateral setae 26 and 31, supra-alar setae 7 on each side. Scutellum with 12 setae in a single row. Wing in Table 2-20 and Fig. 29 A. R 2+3 running close to R 1 but clearly separated at the tip. fCu much beyond r-m. An reaching beyond fCu. Squama with 10 or 8 setae. Relative length of leg segments in Table 3-20. (Front tarsi missing from both specimens). Middle and hind tibiae with two broad terminal combs, one with a spur and the other unarmed. Pulvilli well developed and bifid. Middle and hind tibiae and tarsi I with long beards. Cercus large and relatively long, (128 microns long and 91 microns high; Fig. 29 J). Spermathecae long and ovoid, colorless (Fig. 29 I).

Pupa. Length of abdomen 2.93, 2.40 and 3.02 mm. Distribution of hairs, spines and spinules on abdominal segments II to VII in Fig. 31 A. Tergite I without spines and spinules. Tergite II with an oral transverse spinose area (II-a), a caudal spinose area (II-c), a pair of lateral spinulose areas, and a transverse band of recurved spines (each about 22 microns long) in one or two rows on the intersegmental membrane; the oral and the caudal spinose areas are separated completely by a large spineless area. Tergite III with a wide transverse oral spinose area (each spine about 20 microns long and longer than those of II-a), and a caudal transverse spinose area (III-c) which are also completely separated from the oral spinose area; intersegmental membrane without spines (III-d absent). Tergite IV with an oral transverse spinose area (IV-a), a caudal transverse spinose area (IV-c), and several spines (IV-v) in a longitudinal row between the two transverse band; intersegmental membrane with numerous small recurved spines (IV-d). Tergites V and VI each with an oral transverse spinose area (-a), a central spinose area (-b), and a pair of caudal spinose areas (-c); intersegmental membrane without spines. Tergite VII with a central spinulose area.

Sternites II and III with a large spinulose area. Sternite IV with a pair of small spinulose areas in the middle, a pair of spinulose areas near the caudal margin, and a pair of whirl-like spinose areas (IV-w) in the caudolateral corners. Sternites V, VI and VIII without spines and spinules. Sternite VII with a pair of small lateral spinulose areas. Segments II, III and IV with 3 pairs of short simple lateral hairs, V and VI with 3 pairs of long filamentous lateral hairs, VII and VIII with 4 pairs of long filamentous lateral hairs (Table 4-20). Caudolateral scales on segment VIII are beak-like, and with only one small accessory spur on the inner margin (Fig. 31 C, D). Anal fins with 25-30 (26.8 in average of 3 pairs) long, filamentous fringe hairs.

Discussion. Adult of this species is characteristic in body coloration being almost entirely pale yellow, wing membrane being colorless, and in the structure of male hypopygium, especially that of anal point and dorsal appendage. Among the known species, it seems to be closest to *P. acutum* Kieffer in these respects, but differs from it in the color of thorax (blackish in *acutum* according to Edwards, 1929) and in the structure of dorsal appendage (the present species has 3 long hairs in the middle, and without basal hairs). The present species is also similar in body and wing coloration and in the structure of dorsal appendages to *P. tsukubaense* (Sasa, 1979), which was collected from a mountain stream in Tsukuba, eastern Honshu, but differs in the shape of anal point (more slender in *tsukubaense*) and of gonostylus (more slender in *tsukubaense*). They also differ in the shape of female cercus, in the structure of caudolateral scales on tergite VIII of pupa, abdominal tergites of pupa (II-b, III-b is absent in the present species).

(21) *Polypedilum asakawaense* (Sasa, 1980)

Two males and two females were recovered from samples collected at Station 3, and one male and one female from Station 4. Two pupal exuviae associated with adults are also available (A 46:41, 42), and one of them harbored dead male adult and carried its larval skin. Morphology of male, female and pupa was described by Sasa (1980, p. 34, Plate 41–43). The larva is newly described here, together with redescription of pupal morphology.

Pupa. Length of abdomen 2.93 mm. Distribution of spines and spinules on abdominal tergites in Fig. 32 A. Tergite I with a central spinulose area. Tergite II with a large continuous spinose area (II-a, -b, -c combined), and an uniserial transverse row of small (each about 9 microns long, much shorter than those of *P. kobotokense*) recurved spines on the intersegmental membrane (II-d). Tergites III and IV also with a large continuous spinose area (-a, -b, -c combined), and many small recurved spines in multiple rows but divided in the middle on intersegmental membrane. Tergite V also with a large continuous spinose area (-a, -b, -c combined), but without spines on intersegmental membrane. Spinose areas on tergite VI are separated into the oral (VI-a), middle (VI-b) and the caudal (VI-c) groups. Sternite IV with a pair of whirl-like spinose areas (IV-w, Fig. 32 C) in the caudolateral corners. Sternite V with a pair of small spinose areas (spines are very small and fine, Fig. 32 D) in the caudolateral corners. Caudolateral scales on segment VIII in Figs. 32 E, F, both with a number of accessory spines on the ventral surface and along the outer margin. Anal fins with 30–34 long, filamentous fringe hairs (Fig. 32 G).

Larva. A larval skin attached to dead pupa harboring mature adult male is used for this study. Head capsule 0.47 mm long and 0.33 mm wide. Labial plate (Fig. 33 A) 106 microns wide, with 8 pairs of teeth all evenly pigmented, the second pair being shorter and slightly narrower than the first, third and fourth pairs, the fifth to eighth pairs being further narrower. Paralabial plates (Fig. 33 A) fan-shaped, 106 microns wide and 46 microns long. Antenna 5 segmented (60, 26, 17, 12, 5 microns; Fig. 33 B), segment I 0.92 times as long as combined length of segments II to V, with a ring organ slightly beyond middle; antennal blade 0.7 times as long as the combined length of segments II to V. Mandible (Figs. 33 D, E) 157 microns long and 72 microns wide, with 5 cutting teeth, mandibular brush and subapical comb; inner margin peculiarly serrulated (Fig. 33 D). Labrum, epipharynx and premandible in Fig. 33 C. Claws on posterior pseudopods in Fig. 33 F.

Table 1. Numbers of adult chironomids recovered from bottom samples collected at six stations of the Minamiasakawa River, 12 December 1979 (left: number of males; right: number of females)

Species	1	2	3	4	5	6	Total
1. <i>Orthocladius tamaniitidus</i>		26 28					26 28
2. <i>Orthocladius tamaputridus</i>			8 10	7 4	6 2		21 16
3. <i>Orthocladius yugashimaensis</i>					16 14	9 7	25 21
4. <i>Orthocladius tamarutilus</i>			1 1	3 5	3 2		7 8
5. <i>Orthocladius kanii</i>		1 1					1 1
6. <i>Cricotopus sylvestris</i>						1	1
7. <i>Cricotopus bicinctus</i>			1	19 12	2 1	44 22	66 35
8. <i>Cricotopus tamadigitatus</i>	2	14 7					16 7
9. <i>Cricotopus tamapullus</i>		2 1					2 1
10. <i>Rheocrocotopus tamahumeralis</i>		10 4					10 4
11. <i>Nanocladius tamabicolor</i>				1		1	1 1
12. <i>Paratrachocladius tamaater</i>		2					2
13. <i>Eukiefferiella</i> sp.		2 1					2 1
14. <i>Parakiefferiella tamatriangulatus</i>		2 2	2 4				4 6
15. <i>Brillia japonica</i>			2 1	1			2 2
16. <i>Limnophyes tamakitanaides</i>						1 1	1 1
17. <i>Parametriocnemus stylatus</i>			1 3	1 1			2 4
18. <i>Chironomus yoshimatsui</i>				3 1	12 9	36 40	51 50
19. <i>Dicrotendipes tamaviridis</i>				1			1
20. <i>Polypedilum kobotokense</i>		2 3					2 3
21. <i>Polypedilum asakawaense</i>			2 2	1 1			3 3
22. <i>Rheotanytarsus tamaquartus</i>		7 3					7 3
23. <i>Paratanytarsus parthenogeneticus</i>		62	13	6	2		83

Table 2. Standard measurements of wing venation

Code No.	Species	Sex	WL (mm)	Percentage to wing length												
				ww	Rs	Sc	R1	R2+3	R4+5	Cs	M	Cu1	Cu2	An	r-m	fCu
1.	<i>Orthocladius tamanitidus</i>	M	1.92	26	15	62	74	86	94	97	99	91	75	61	51	55
		F	2.08	31	15	59	72	79	93	96	99	88	71	59	57	48
2.	<i>Orthocladius tamaputridus</i>	M	2.26	24	14	63	73	81	93	95	99	92	73	61	49	51
		F	1.89	34	13	63	72	79	94	97	99	91	72	59	47	49
4.	<i>Orthocladius tamarutilus</i>	M	1.63	27	14	60	73	87	94	97	99	91	73	60	47	51
		F	1.58	31	15	53	74	79	94	97	99	91	72	56	46	49
8.	<i>Cricotopus tamadigitatus</i>	M	1.79	26	13	51	71	83	96	97	99	89	69	51	44	49
		F	1.79	29	13	49	67	83	96	97	99	90	66	50	43	49
9.	<i>Cricotopus tamapullus</i>	M	1.61	27	14	58	72	85	93	96	99	90	72	58	49	54
		F	1.52	31	15	54	70	85	93	96	99	88	66	55	46	50
10.	<i>Rheocricotopus tamahumeralis</i>	M	2.12	26	13	57	71	81	94	97	99	91	74	57	47	50
		F	2.12	30	15	60	73	81	97	99	99	90	74	57	49	49
14.	<i>Parakiefferiella tamatriangulatus</i>	M	1.05	30	13	54	67	79	86	94	98	89	71	46	43	46
		F	0.92	33	15	49	71	82	85	95	98	88	67	47	42	45
16.	<i>Limnophyes tamakitanaides</i>	M	1.52	26	13	57	67	77	91	96	99	86	66	51	46	54
		F	1.35	31	14	54	66	74	90	96	99	87	66	51	46	53
19.	<i>Dicrotendipes tamaviridis</i>	M	2.09	23	15	69	77	85	97	98	99	87	66	56	49	56
20.	<i>Polypedilum kobotokense</i>	M	2.15	25	16	60	78	84	99	99	97	88	65	56	60	56
		F	2.15	28	17	63	79	81	99	99	98	90	72	59	49	56

Table 3. Standard measurements of legs

Code No.	Species	Sex	Leg No.	Length in 0.01mm unit							Ratios	
				fe	ti	t1	t2	t3	t4	t5	LR	BR
1	<i>Orthocladius tamanitidus</i>	M	1	72	84	65	40	29	18	11	0.77	2.0
			2	72	69	40	23	17	10	9	0.58	3.8
			3	74	84	48	29	21	11	9	0.57	3.0
		F	1	85	95	68	40	29	19	12	0.72	2.0
			2	83	85	45	27	17	11	11	0.53	2.1
			3	79	100	60	33	24	12	12	0.60	2.2
2	<i>Orthocladius tamaputridus</i>	M	1	80	88	60	35	26	17	12	0.68	1.9
			2	75	75	40	23	16	12	11	0.53	3.0
			3	80	85	48	26	21	11	11	0.56	3.5
		F	1	69	81	63	37	28	17	10	0.77	1.8
			2	65	65	39	22	16	12	10	0.60	2.2
			3	68	79	50	28	21	12	10	0.63	2.4
4	<i>Orthocladius tamarutilus</i>	M	1	62	71	51	32	24	16	10	0.71	1.5
			2	61	58	30	17	14	10	8	0.53	1.3
			3	62	72	43	23	18	12	9	0.59	1.3
		F	1	56	63	44	27	20	14	10	0.69	1.6
			2	57	55	28	14	12	8	8	0.52	1.8
			3	62	63	41	22	15	10	9	0.65	1.8
8	<i>Cricotopus tamadigitatus</i>	M	1	72	89	60	29	23	16	11	0.67	1.8
			2	80	71	37	20	15	10	9	0.52	2.5
			3	72	81	47	24	20	12	10	0.58	3.1
		F	1	72	89	56	27	21	15	11	0.63	4.0
			2	75	74	36	16	15	10	8	0.49	3.2
			3	76	77	45	22	19	10	9	0.58	3.6
9	<i>Cricotopus tamapullus</i>	M	1	56	67	37	23	—	—	—	0.55	2.2
			2	58	58	26	15	13	9	8	0.45	2.3
			3	56	63	35	19	16	10	9	0.55	2.6
		F	1	52	63	34	15	14	12	9	0.54	1.5
			2	56	57	27	13	11	8	8	0.47	1.6
			3	57	62	34	19	15	9	9	0.55	1.6
10	<i>Rheocricotopus tamahumeralis</i>	M	1	59	70	49	27	20	13	8	0.69	1.7
			2	64	69	35	16	13	7	7	0.51	2.2
			3	59	68	42	22	18	7	7	0.61	2.9
		F	1	68	83	61	34	24	14	10	0.73	2.1
			2	73	77	39	20	13	8	8	0.51	1.7
			3	68	83	48	23	19	10	9	0.58	1.7
14	<i>Parakiefferiella tamahumeralis</i>	M	1	34	42	24	20	14	8	6	0.58	2.8
			2	37	35	16	10	8	5	5	0.47	3.4
			3	36	39	22	13	12	5	5	0.57	5.0

Table 3. (continued)

Code No.	Species	Leg Sex No.	Length in 0.01mm unit								Ratios	
			Fe	ti	t1	t2	t3	t4	t5	LR	BR	
16	<i>Limnophyes tamakitanaides</i>	F	1	30	34	18	13	10	5	5	0.54	2.3
			2	31	29	13	7	6	4	4	0.47	2.6
			3	31	33	17	10	10	5	5	0.53	2.6
		M	1	56	72	40	24	16	10	9	0.55	0.9
			2	54	61	33	16	12	7	8	0.54	2.3
			3	62	73	40	20	16	8	9	0.53	2.7
		F	1	61	57	32	19	14	8	7	0.55	1.6
			2	52	50	27	13	10	5	6	0.54	1.7
			3	56	59	32	16	15	7	7	0.54	1.7
19	<i>Dicrotendipes tamaviridis</i>	M	1	92	65	117	61	51	39	19	1.82	2.2
			2	78	72	38	22	16	9	8	0.53	3.0
			3	90	108	66	33	27	17	11	0.61	4.4
20	<i>Polypedilum kobotokense</i>	M	1	98	59	117	80	53	43	19	1.98	2.5
			2	103	83	48	28	21	14	8	0.58	4.2
			3	102	94	70	41	33	11	10	0.75	4.5
		F	1	101	70	—	—	—	—	—	—	—
			2	107	90	51	30	21	15	8	0.57	4.3
			3	116	101	74	43	34	22	10	0.73	5.7

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EXPLANATION OF FIGURES

(1) *Orthocladus (Orthocladus) tamanitidus*, sp. nov.

Plate 1. Adult. A. Wing, female. B. wing, male. C. scutum and scutellum, female. D. head, female. E. Antenna, female. F. spermathecae, female. G. cercus, female. H. head, male. I. tip of antenna, male. J. abdominal tergites II-IX and hypopygium, male.

Plate 2. Male. A. hypopygium, dorsal aspect. B. inner margin of gonocoxite, ventral aspect, showing double inner lobes (left side) and basal lobes (both sides). C. inner lobes of gonocoxite, dorsal aspect. D. front tarsus V, showing claws and empodium, pulvilli absent. E. tip of middle tibia. F. tip of hind tibia, showing terminal comb. G. tip of hind tibia, showing terminal spurs. H. tip of front tibia. I. hypopygium, ventral aspect. J. thorax (scutum and scutellum), dorsal view.

Plate 3. Pupa. A. thoracic respiratory organ. B. abdominal tergites I-VII. C-F. enlarged view of a part of spinose areas on tergites II to V. G-J. enlarged view of spinose areas in caudolateral corners of sternites IV-VII. K. tergite VIII and anal segment.

Plate 4. Larva. A. Maxilla. B. antenna. C. antenna and mandible. D. eyes. E. labrum. F. labrum, epipharynx and premandible. G. labial plate. H. claws on anterior pseudopods. I. bases of preanal hair tuft. J. terminal segments, lateral view. K. claws on posterior pseudopods.

(2) *Orthocladus (Orthocladus) tamaputridus*, sp. nov.

Plate 5. Adult. A. wing, male (above) and female (below). B. head, female. C. antenna, female. D. head, male. E. tip of antenna, male. F. scutum and scutellum, dorsal view, male. G. tip of hind tarsus V, female. H. abdominal tergite II, male. I. abdominal tergites VII and VIII, male. J. spermathecae, female. K. cercus, female.

Plate 6. Male. A. hypopygium, dorsal view. B. ventral view of inner margin of gonocoxite. C. ninth tergite and anal point. D. dorsal aspect of gonostylus. E. ventral aspect of gonostylus. F. dorsal aspect of inner lobes of gonocoxite. G. do, ventral aspect. H. tip of front tibia. I. tip of middle tibia. J, K. tip of hind tibia. L. front tarsus I, showing claws, empodium, and absence of pulvilli.

Plate 7. Pupa. A. thoracic respiratory organ. B. dorsal view of abdomen. C. a part of spinose areas on tergite II. D. do, tergite III. E. do, tergite IV. F. caudolateral spinose areas on sternites IV, V, VI and VII. G. dorsal view of segments VIII and IX. H. base of terminal setae of anal fin.

(4) *Orthocladus (Orthocladus) tamarutilus*, sp. nov.

Plate 8. Adult. A. wing. B. head, female. C. antenna, female. D. scutum and scutellum, female. E. dorsolateral setae, female. F. head, male. G. tip of antenna, male. H. scutum and scutellum, male. I. antepronotum, male. J. spermathecae, female. K. cercus, female.

Plate 9. Male. A. hypopygium, dorsal aspect. B. inner lobes of gonocoxite, and gonostylus, dorsal aspect. C. variation of anal point. D. hypopygium, ventral aspect. E. tip of middle tibia. F. tip of front tibia. G. tip of hind tibia, showing terminal spurs.

EXPLANATION OF FIGURES

(1) *Orthocladus (Orthocladus) tamanitidus*, sp. nov.

Plate 1. Adult. A. Wing, female. B. wing, male. C. scutum and scutellum, female. D. head, female. E. Antenna, female. F. spermathecae, female. G. cercus, female. H. head, male. I. tip of antenna, male. J. abdominal tergites II-IX and hypopygium, male.

Plate 2. Male. A. hypopygium, dorsal aspect. B. inner margin of gonocoxite, ventral aspect, showing double inner lobes (left side) and basal lobes (both sides). C. inner lobes of gonocoxite, dorsal aspect. D. front tarsus V, showing claws and empodium, pulvilli absent. E. tip of middle tibia. F. tip of hind tibia, showing terminal comb. G. tip of hind tibia, showing terminal spurs. H. tip of front tibia. I. hypopygium, ventral aspect. J. thorax (scutum and scutellum), dorsal view.

Plate 3. Pupa. A. thoracic respiratory organ. B. abdominal tergites I-VII. C-F. enlarged view of a part of spinose areas on tergites II to V. G-J. enlarged view of spinose areas in caudolateral corners of sternites IV-VII. K. tergite VIII and anal segment.

Plate 4. Larva. A. Maxilla. B. antenna. C. antenna and mandible. D. eyes. E. labrum. F. labrum, epipharynx and premandible. G. labial plate. H. claws on anterior pseudopods. I. bases of preanal hair tuft. J. terminal segments, lateral view. K. claws on posterior pseudopods.

(2) *Orthocladus (Orthocladus) tamaputridus*, sp. nov.

Plate 5. Adult. A. wing, male (above) and female (below). B. head, female. C. antenna, female. D. head, male. E. tip of antenna, male. F. scutum and scutellum, dorsal view, male. G. tip of hind tarsus V, female. H. abdominal tergite II, male. I. abdominal tergites VII and VIII, male. J. spermathecae, female. K. cercus, female.

Plate 6. Male. A. hypopygium, dorsal view. B. ventral view of inner margin of gonocoxite. C. ninth tergite and anal point. D. dorsal aspect of gonostylus. E. ventral aspect of gonostylus. F. dorsal aspect of inner lobes of gonocoxite. G. do, ventral aspect. H. tip of front tibia. I. tip of middle tibia. J, K. tip of hind tibia. L. front tarsus I, showing claws, empodium, and absence of pulvilli.

Plate 7. Pupa. A. thoracic respiratory organ. B. dorsal view of abdomen. C. a part of spinose areas on tergite II. D. do, tergite III. E. do, tergite IV. F. caudolateral spinose areas on sternites IV, V, VI and VII. G. dorsal view of segments VIII and IX. H. base of terminal setae of anal fin.

(4) *Orthocladus (Orthocladus) tamarutilus*, sp. nov.

Plate 8. Adult. A. wing. B. head, female. C. antenna, female. D. scutum and scutellum, female. E. dorsolateral setae, female. F. head, male. G. tip of antenna, male. H. scutum and scutellum, male. I. antepronotum, male. J. spermathecae, female. K. cercus, female.

Plate 9. Male. A. hypopygium, dorsal aspect. B. inner lobes of gonocoxite, and gonostylus, dorsal aspect. C. variation of anal point. D. hypopygium, ventral aspect. E. tip of middle tibia. F. tip of front tibia. G. tip of hind tibia, showing terminal spurs.

H. tip of hind tibia, showing terminal comb. I. abdominal tergites.

Plate 10. Pupa A. thoracic respiratory organ. B. abdominal tergites. C. spinose areas on tergite II, lateral and caudal part. D. spinose areas on tergite III, middle part (III b, III c, and III d). E. spinose areas on tergite IV, middle part (IV b, IV c and IV d). F-I. caudolateral spinose areas on sternites IV to VII (IV w to VII w). J. dorsal view of anal segments.

(8) *Cricotopus tamadigitatus*, sp. nov.

Plate 11. Adult A. antenna, female. B. head, female. C. wing, male and female. D. head, male. E. dorsal view of scutum and scutellum, female. F. spermathecae, female. G. cercus, female.

Plate 12. Male hypopygium. A. dorsal view. B. inner lobe of gonocoxite and gonostylus. C. inner lobe of gonocoxite, enlarged. D. tip of gonostylus, enlarged. E. ventral view of hypopygium.

Plate 13. Male. A. abdominal tergites. B. scutum and scutellum. C. coloration of front leg. D. tip of front tibia. E. tip of middle tibia. F, G. tip of hind tibia. H. front tarsus V.

Plate 14. Pupa. A. thoracic respiratory organs. B. abdomen, lateral view. C. spinose areas on tergite II (II c and II d), central part. D. recurved spines of tergite II d. E. spines of III b, lateral view. F. spinose areas on tergite III (III b, III c and III d). G. spines of III c. H. spines of III d. I. spinose areas on tergite IV (IV b and IV c). J. spines of IV b, IV c and IV d. K. caudolateral spinose areas on sternites IV, V and VI. L. spines of IV w. M. spinules of sternite IV (IV v). N. spinules of tergite VIII. O. anal segments, dorsal view.

(9) *Cricotopus tamapullus*, sp. nov.

Plate 15. Adult. A. wing, male and female. B. head, female. C. antenna, female. D. scutum and scutellum, male. E. scutum and scutellum, female. F. abdominal tergites. G. tarsus V of female. H. tip of front tibia, female. I. tip of middle tibia, female. J, K. tip of hind tibia, female. L. spermathecae, female. M. cercus, female.

Plate 16. Male. A. head. B. tip of antenna. C. middle tarsus V, showing a claw, empodium, and absence of pulvilli. D. inner lobe of gonocoxite, dorsal view. E. inner lobe of gonocoxite, ventral view. F. hypopygium, dorsal view. G. base of gonocoxite, ventral view. H. tip of front tibia. I. tip of middle tibia. J, K. tip of hind tibia.

Plate 17. Pupa. A. thoracic respiratory organs. B. thoracic respiratory organ and three long hairs arising from a tubercle. C. lateral view of abdominal segments. D. spines of II d. E. spinose areas on tergite III, middle part, lateral view (III b, III c and III d). F. spinose areas on tergite VI (VI b and VI c, VI d absent). G. whirl-like spinose area in caudolateral corners of sternite IV (IV w). H. lateral view of anal segment.

(10) *Rheocricotopus tamahumeralis*, sp. nov.

Plate 18. Adult. A. wing, male and female. B. head, female. C. antenna, female. D. thorax, lateral, male. E. thorax, lateral, female. F. abdomen, dorsal, male. G. spermathecae, female. H. cercus, female.

Plate 19. Male. A. head. B. tip of antenna. C. tip of front tibia. D. tip of middle

tibia. E, F. tip of hind tibia. G. hind tarsus V. H. hypopygium, dorsal view. I. hypopygium, ventral view. J. inner lobe of gonocoxite, ventral view.

Plate 20. Pupa. A. thoracic respiratory organ. B. abdominal tergites. C. spinose areas on tergites II and III. D. spinose areas on tergite V. E. caudolateral spinose areas on sternites, IV-v, and V-v. F. Anal segments, left half.

(14) *Parakiefferiella tamatriangulatus*, sp. nov.

Plate 21. Male and female A. wing. B. head, male. C. tip of male antenna. D. abdominal tergites, male. E. head, female. F. antenna, female. G. thorax, female. H. spine group on scutum, female. I. spermathecae. J. cercus.

Plate 22. Male. A. thorax, dorsal view. B. spine group on scutum, lateral view. C. tip of front tibia. D. tip of middle tibia. E, F. tip of hind tibia. G. hind tarsus V, showing absence of pulvilli. H. hypopygium, dorsal view. I. hypopygium, ventral view. J. ninth tergite and anal point. K. enlarged view of inner margin of gonocoxite and gonostylus.

Plate 23. Pupa. A. abdominal tergites. B. spinose areas on tergites. C. lateral hairs on abdominal segment VIII, showing the first one being flat. D. anal segment, dorsal view. E. thoracic respiratory organ.

(16) *Limnophyes tamakitanoides*, sp. nov.

Plate 24. Female (excepting a male wing). A. wing. B. head. C. antenna. D. antep pronotum. E. scutum and scutellum, dorsal view. F. dorsolateral setae on scutum, posterior group. G. tip of front tibia. H. tip of middle tibia. I. tip of hind tibia. J. hind tarsus V. K. spermathecae. L. cercus.

Plate 25. Male. A. head. B. tip of antenna. C. antep pronotum. D. thorax, dorsal view. E. dorsolateral setae, posterior group. F. tip of front tibia. G. tip of middle tibia. H, I. tip of hind tibia. J. front tarsus V. K. abdomen, dorsal view.

Plate 26. Male hypopygium. A. dorsal view. B. ninth tergite. C. inner lobe of gonocoxite. D. gonostylus. E. ventral view of hypopygium.

(19) *Dicrotendipes tamaviridis* sp. nov.

Plate 27. Male. A. hypopygium, ventral view. B. hypopygium, dorsal view. C. anal point. D. tip of gonostylus. E. dorsal appendage, dorsal view. F. dorsal appendage, ventral view. G. ventral appendages, dorsal view. H. middle tarsus V, showing pulvilli, empodium and claws. I. tip of front tibia. J. tip of middle tibia. K. tip of hind tibia. L. wing.

Plate 28. Male and pupa. A. head, male. B. tip of antenna. C. abdominal tergites II-IX, pupa. D. spinose areas on tergite II (II-c and II-d, middle part, and II-d, lateral part). E. spinose areas on tergite III. F. spinose areas on tergite IV. G. spinose areas on tergite V. H. a part of proximal spinulous areas on tergite VIII (VIII-b). I. a part of caudal spinulous areas on tergite VIII (VIII-c). J. spinose area in caudolateral corners of sternite IV (IV-w). K. spinose area in caudolateral corners of sternite V (V-w). L. caudolateral scale and lateral hairs III and IV of abdominal segment VIII.

(20) *Polypedilum kobotokense* sp. nov.

Plate 29. Adult. A. wing, male and female. B. head, female. C. antenna, female. D.

head, male. E. tip of antenna, male. F. tip of front tibia, male. G. tip of middle tibia, male. H. middle tarsus V, showing pulvilli, empodium and claws (plv, emp, clw).

Plate 30. Male hypopygium. A. dorsal view. B. ventral view. C. ninth tergite and anal point, dorsal view. D. anal point, ventral view. E. dorsal appendage. F. ventral appendage, dorsal view. G. tip of gonostylus.

Plate 31. Pupa. A. abdominal segments II to VII, lateral view. B. enlarged view of some parts of spinose areas on tergites. C, D. caudolateral scales on segment VIII. E. whirl-like spinose area on sternite IV (IV-w). F. abdominal segments VIII and IX.

(21) *Polypedilum asakawaense* (Sasa, 1980)

Plate 32. Pupa. A. abdominal tergites I-VI. B. some spines and spinules on tergites II (left), III (middle) and IV (right). C. spine groups in caudolateral corner of sternite IV. D. base of third lateral hairs and spine groups in caudolateral corner of sternite V. E, F. caudolateral scales of abdominal segment VIII. G. anal segments.

Plate 33. Larva. A. labial and paralabial plates. B. antenna. C. labrum, epipharynx and premandibles. D. mandible, ventral view. E. mandible, dorsal view. F. claws on posterior pseudopods.

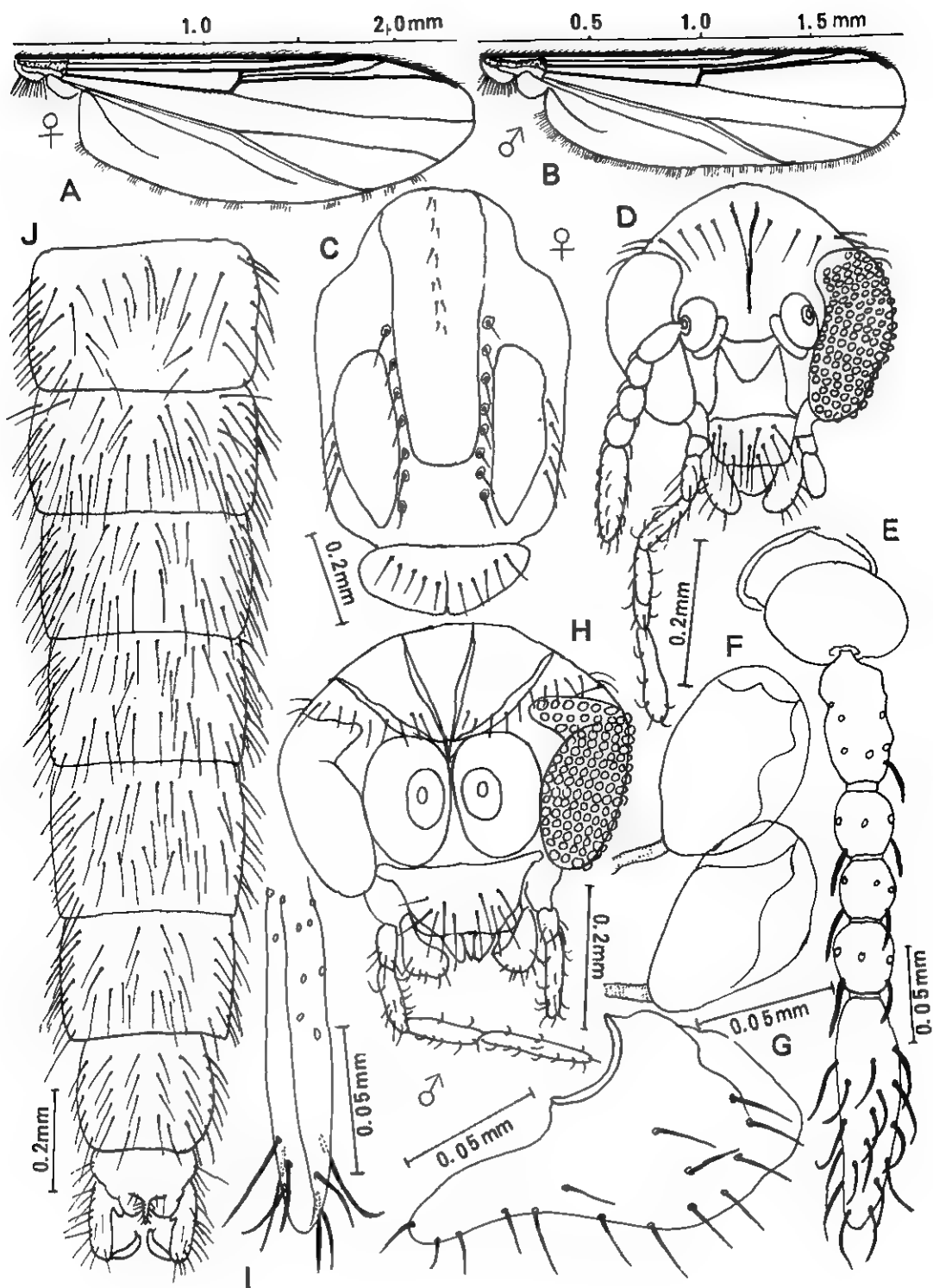


Plate 1. *Orthocladus tamanitidis*, sp. nov., male and female

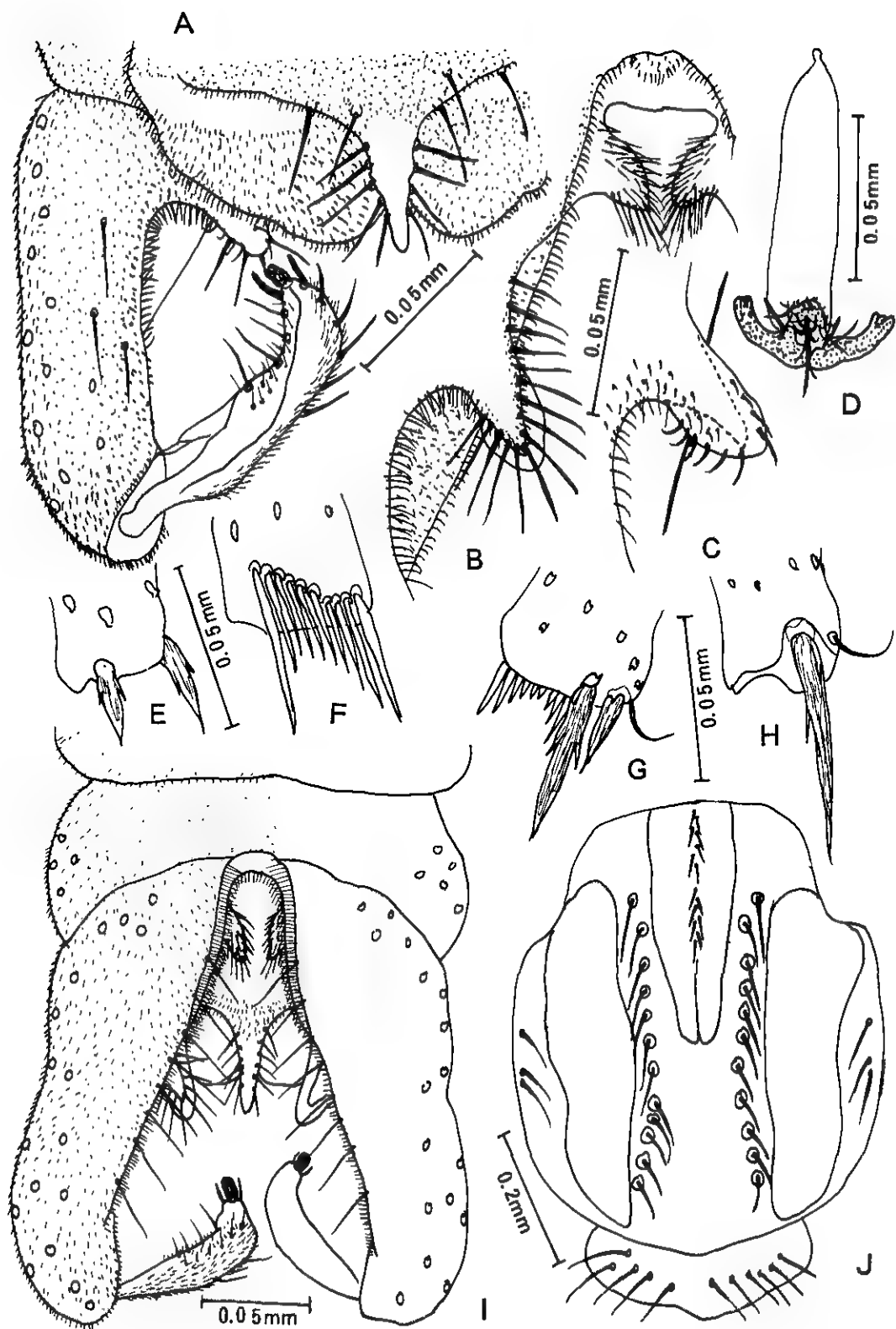


Plate 2. *Orthocladius tamanitidus*, sp. nov., male

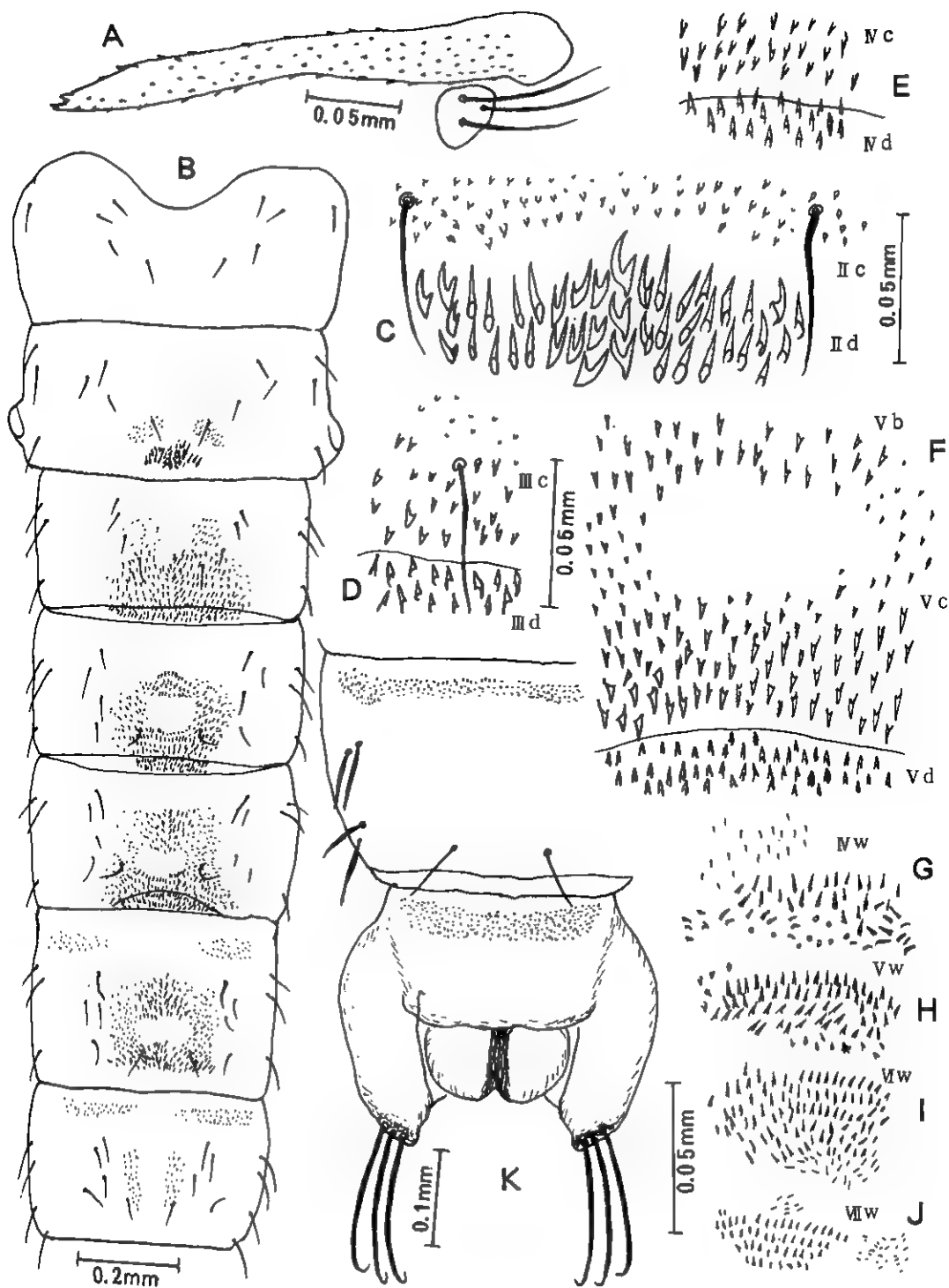


Plate 3. *Orthocladus tamanitidus*, sp. nov., pupa

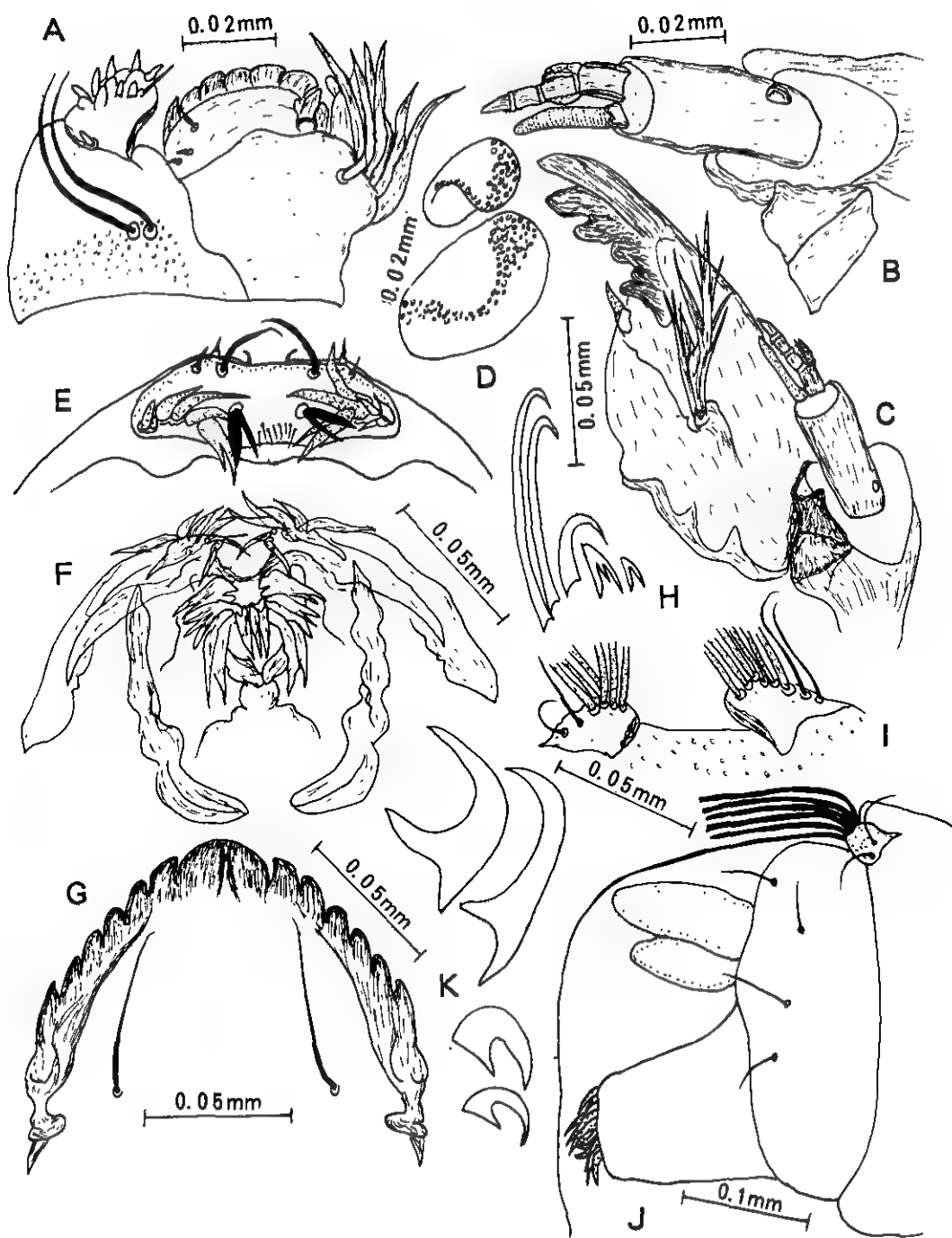


Plate 4. *Orthocladius tamanitidus*, sp. nov., larva

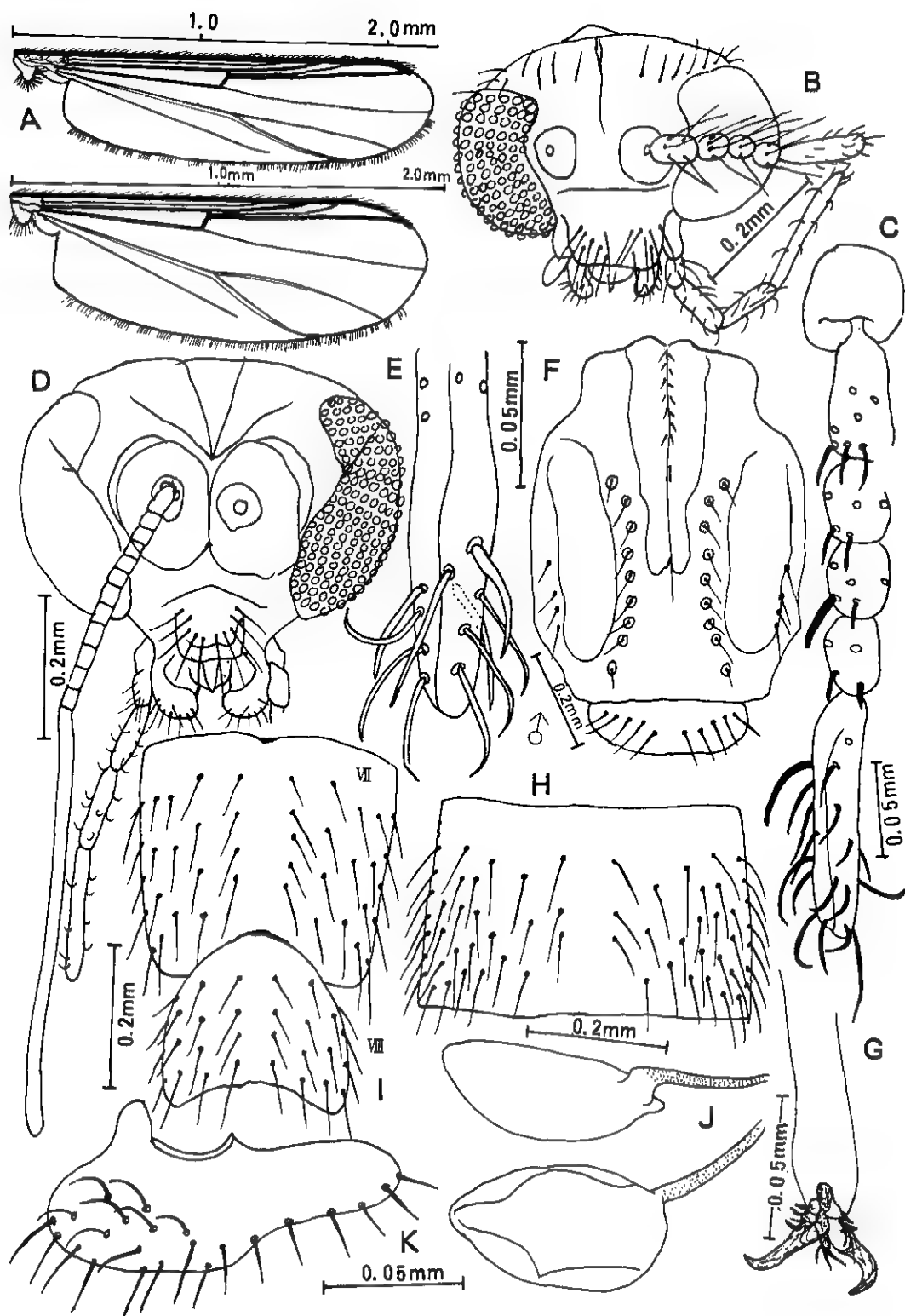


Plate 5. *Orthocladus tamaputridus*, sp. nov., male and female

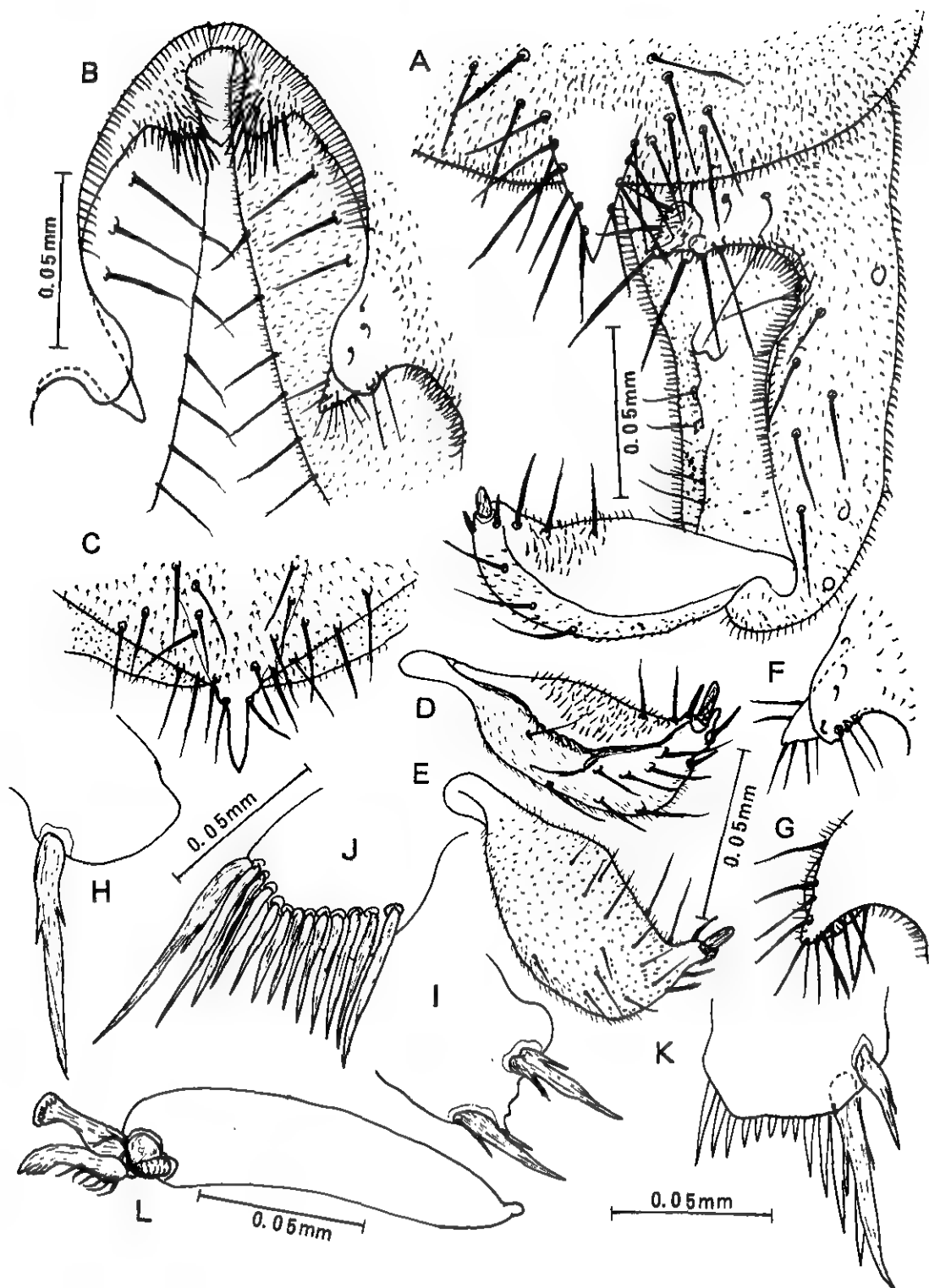


Plate 6. *Orthocladus tamaputridus*, sp. nov., male

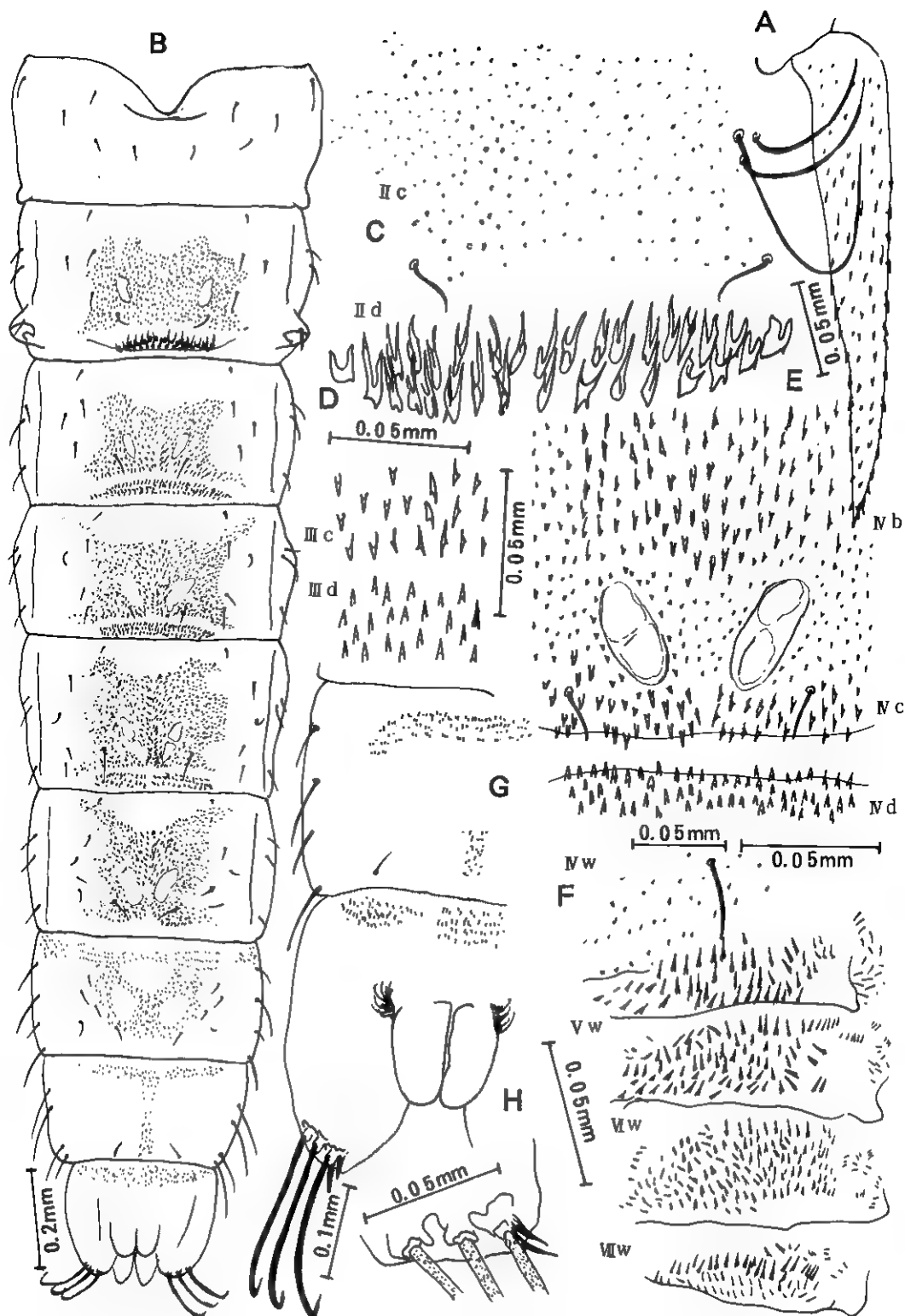


Plate 7. *Orthocladius tamaputridus*, sp. nov., pupa

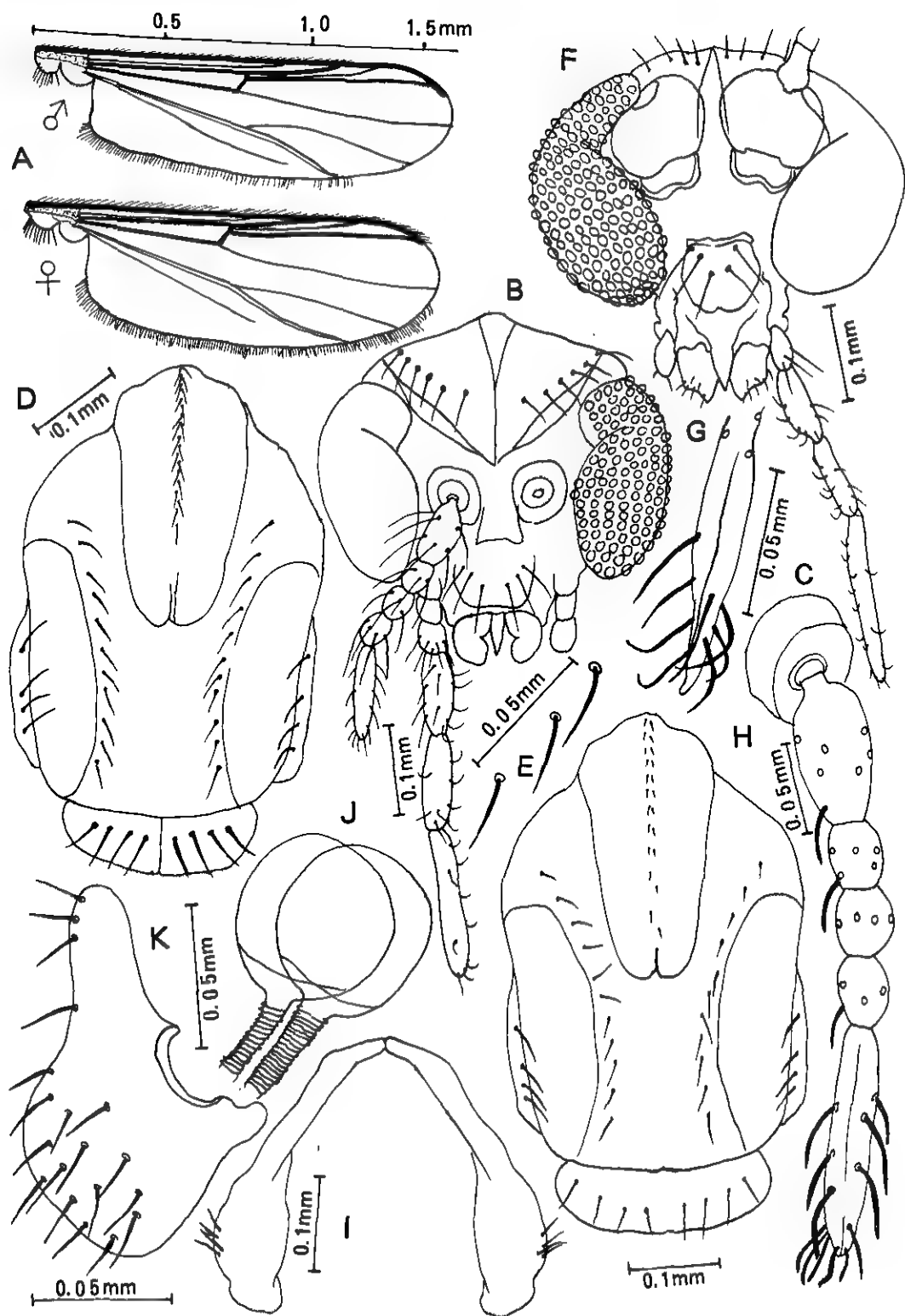


Plate 8. *Orthocladus tamarutilus*, sp. nov., male and female

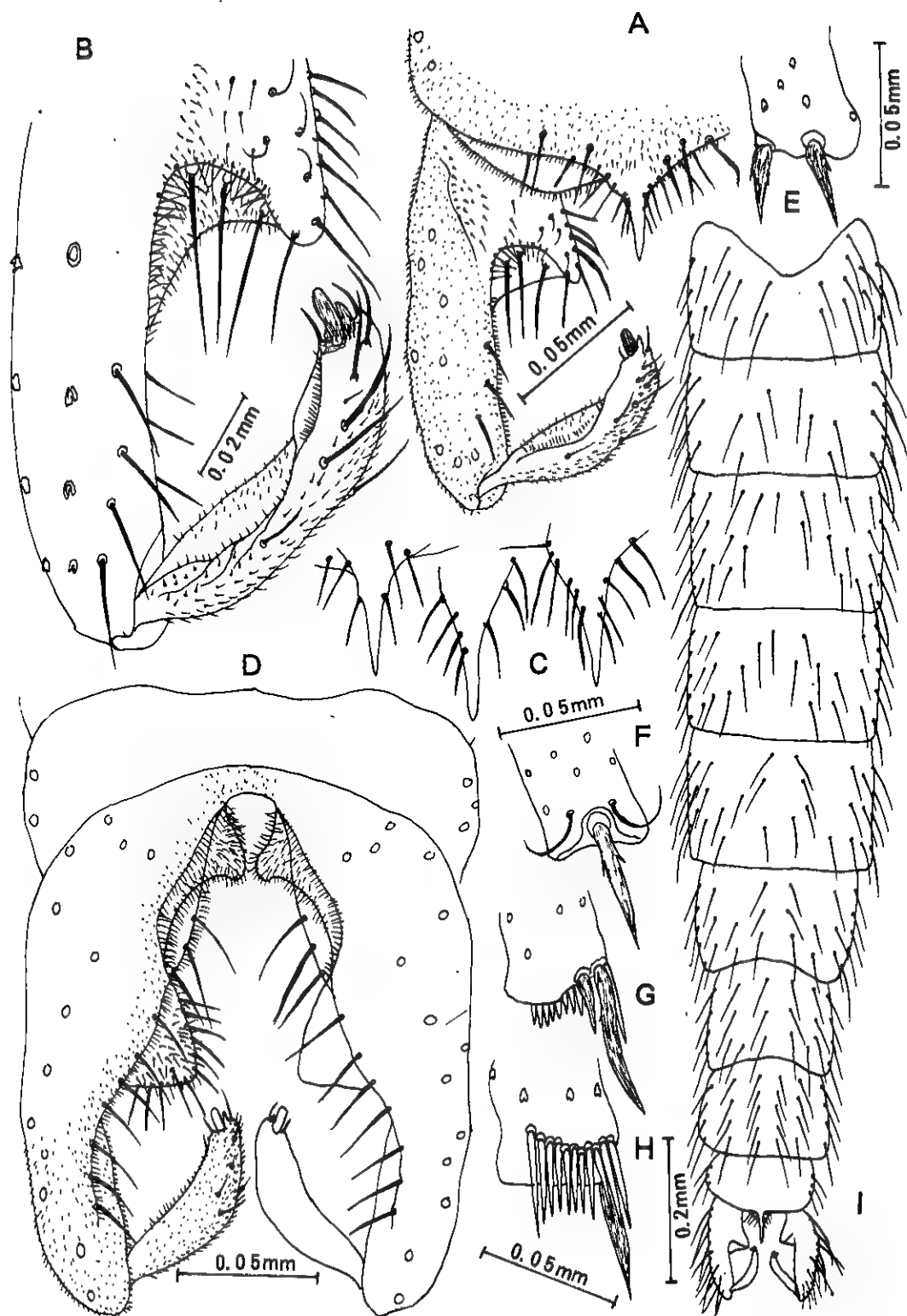


Plate 9. *Orthocladius tamarutilus*, sp. nov., male

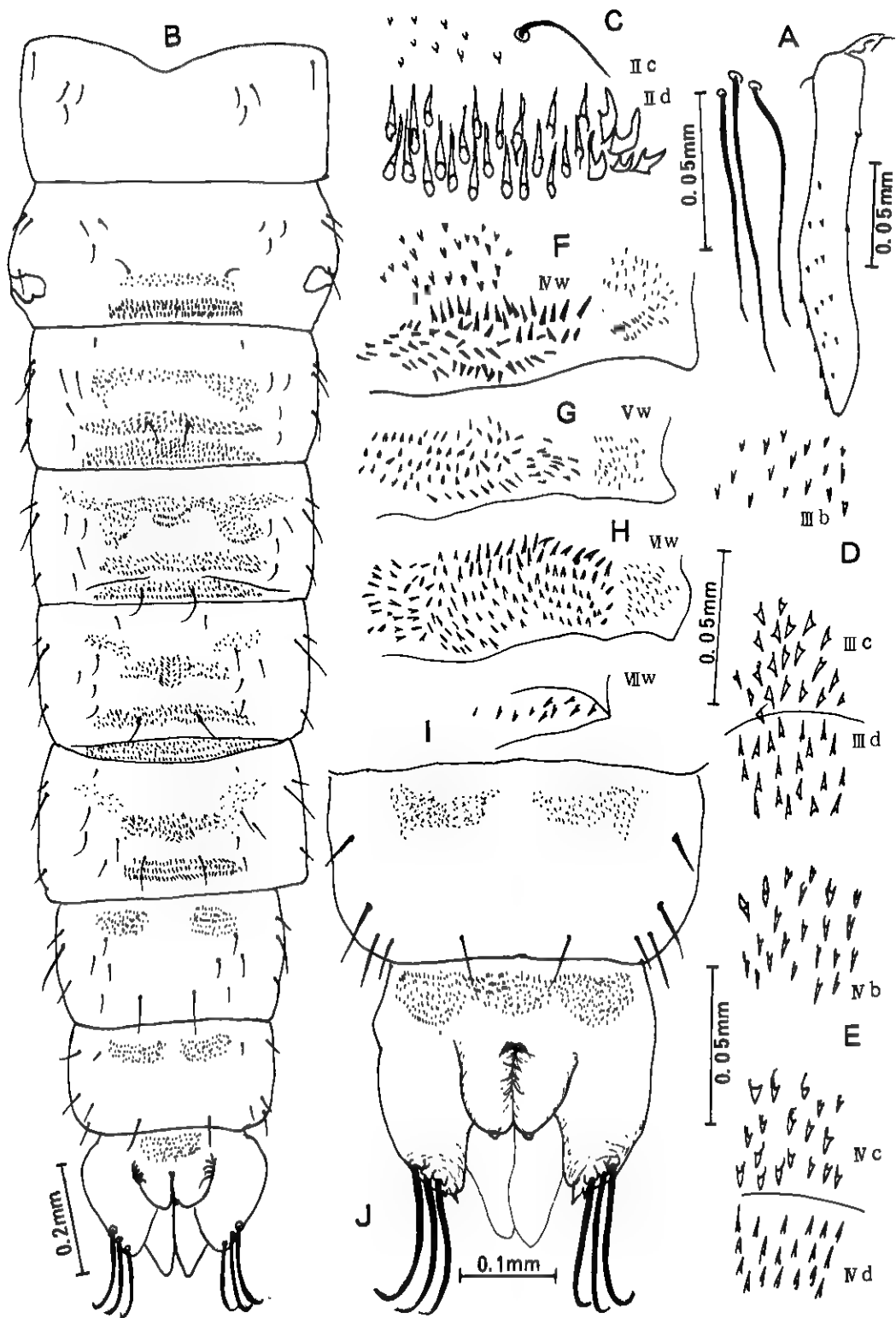


Plate 10. *Orthocladius tamarutilus*, sp. nov., pupa

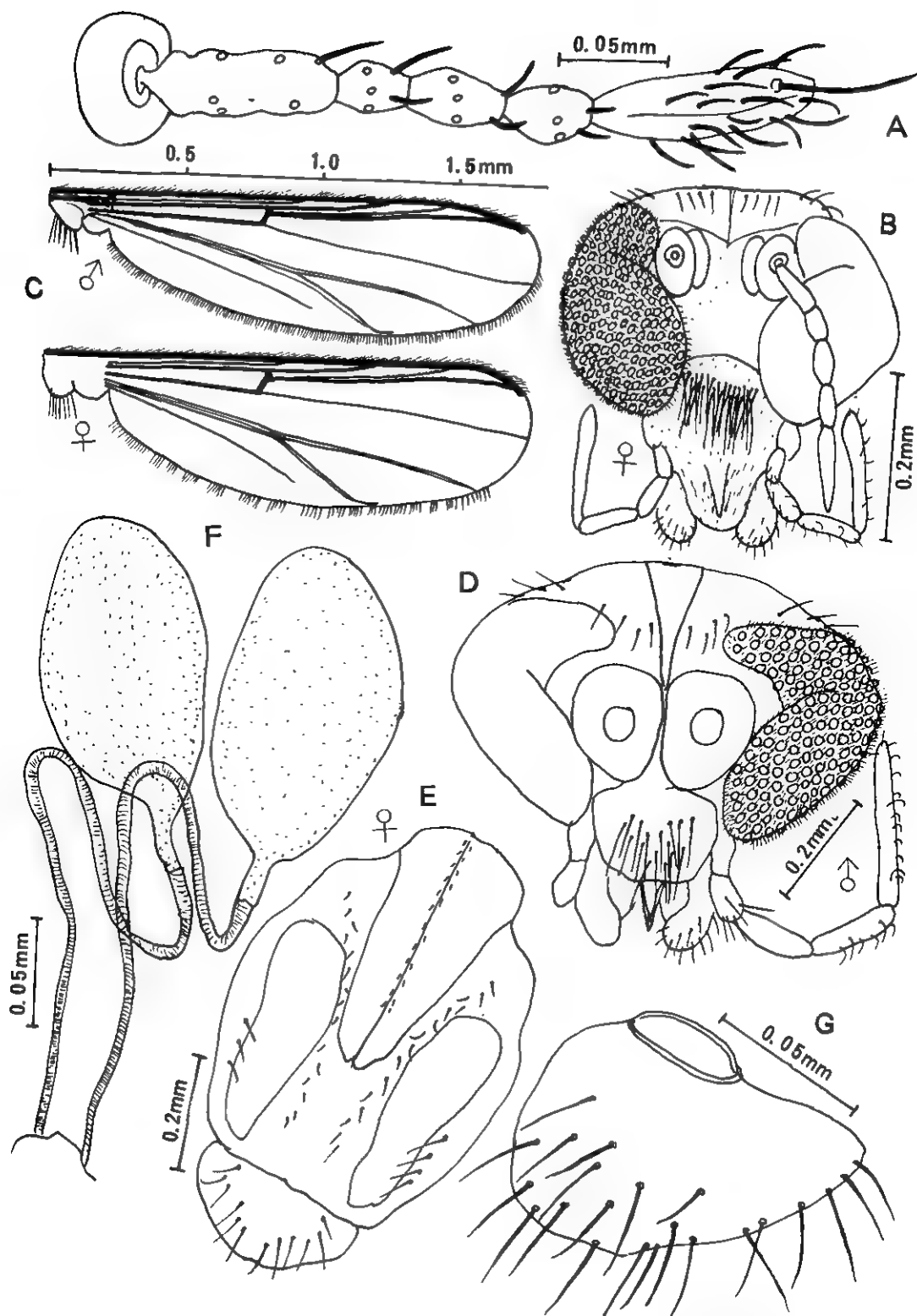


Plate 11. *Cricotopus tamadigitatus*, sp. nov., male and female

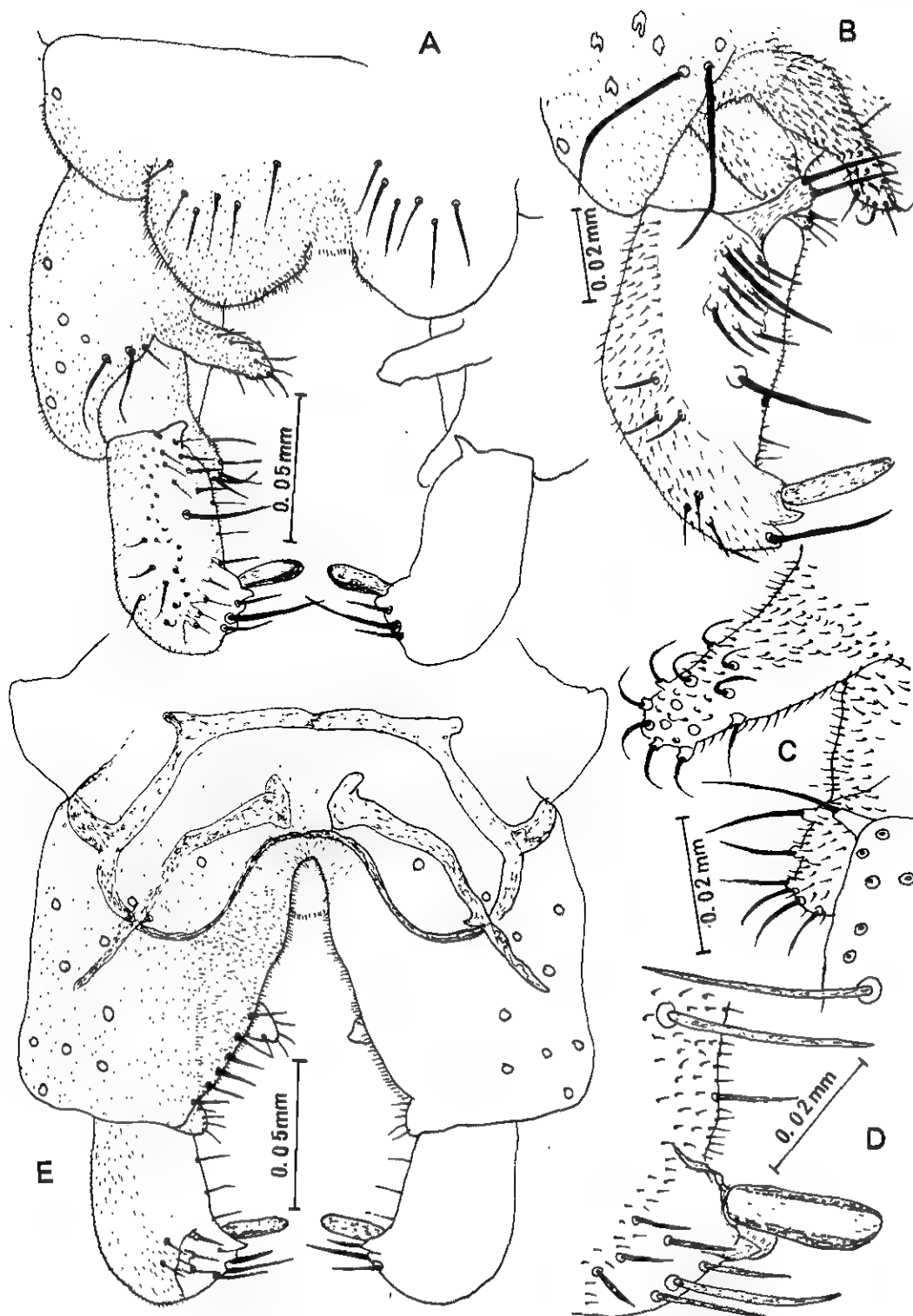


Plate 12. *Cricotopus tamadigitatus*, sp. nov., male hypopygium

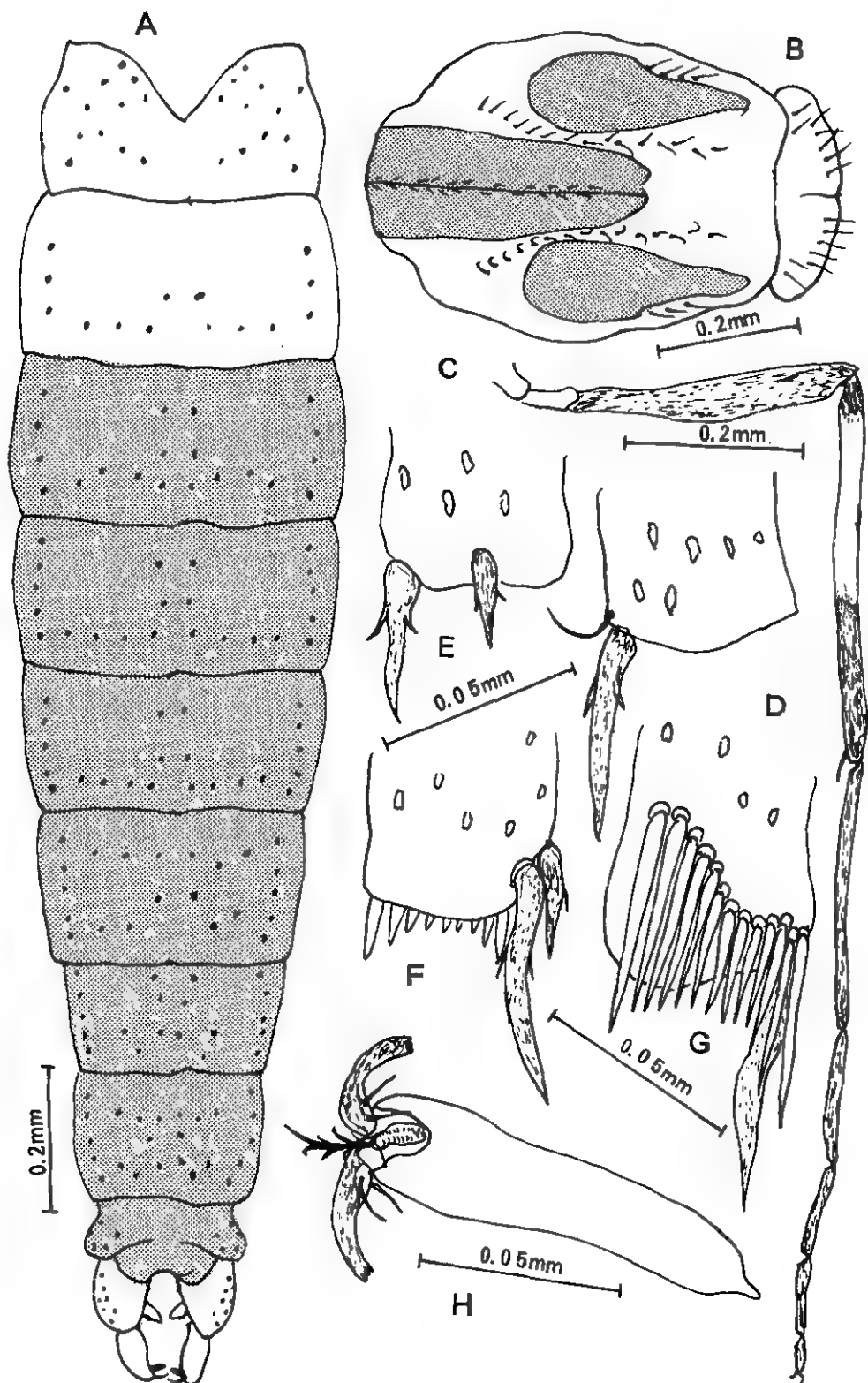


Plate 13. *Cricotopus tamadigitatus*, sp. nov., male

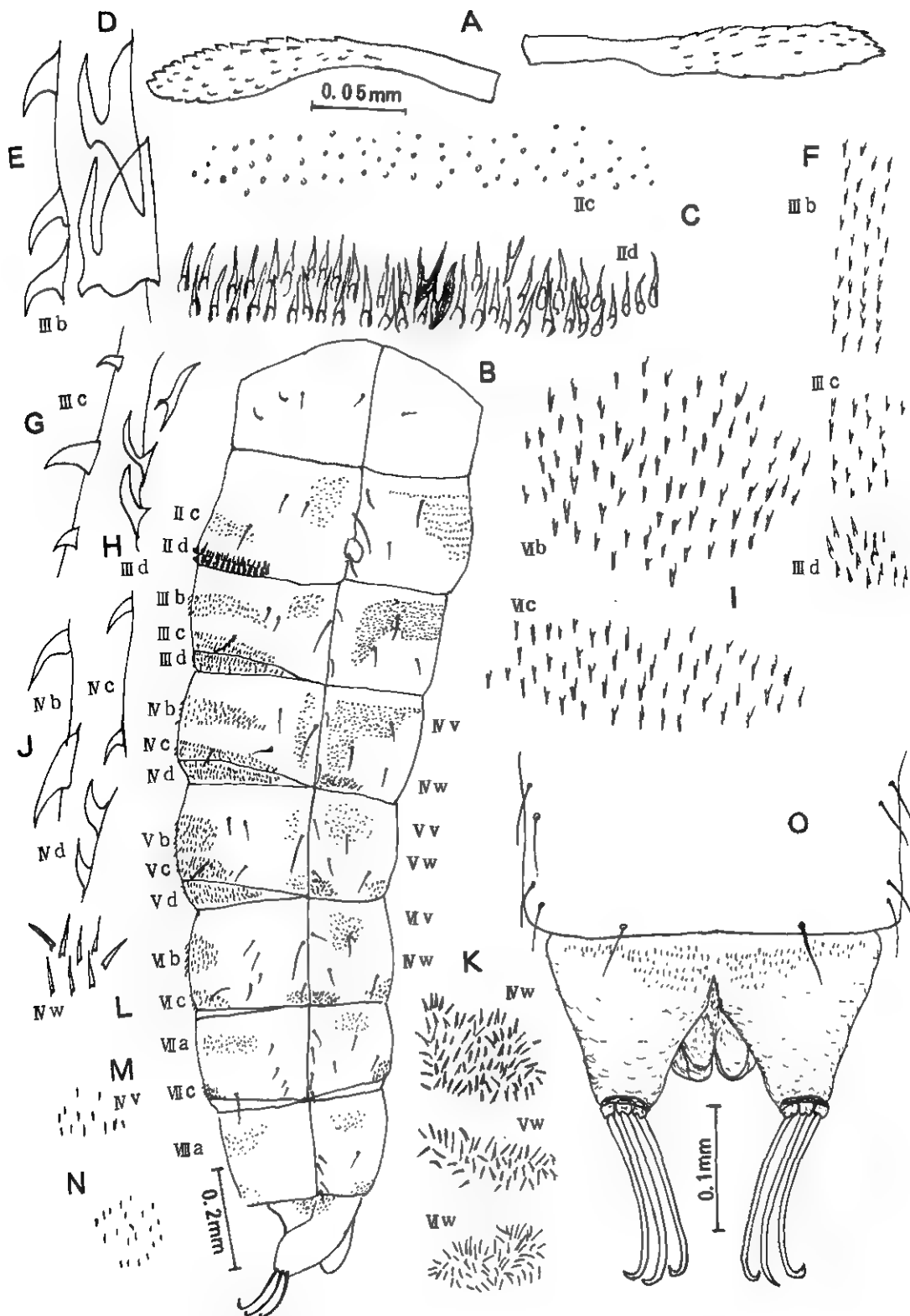


Plate 14 *Cricotopus tamadigitatus*, sp. nov., nov., pupa

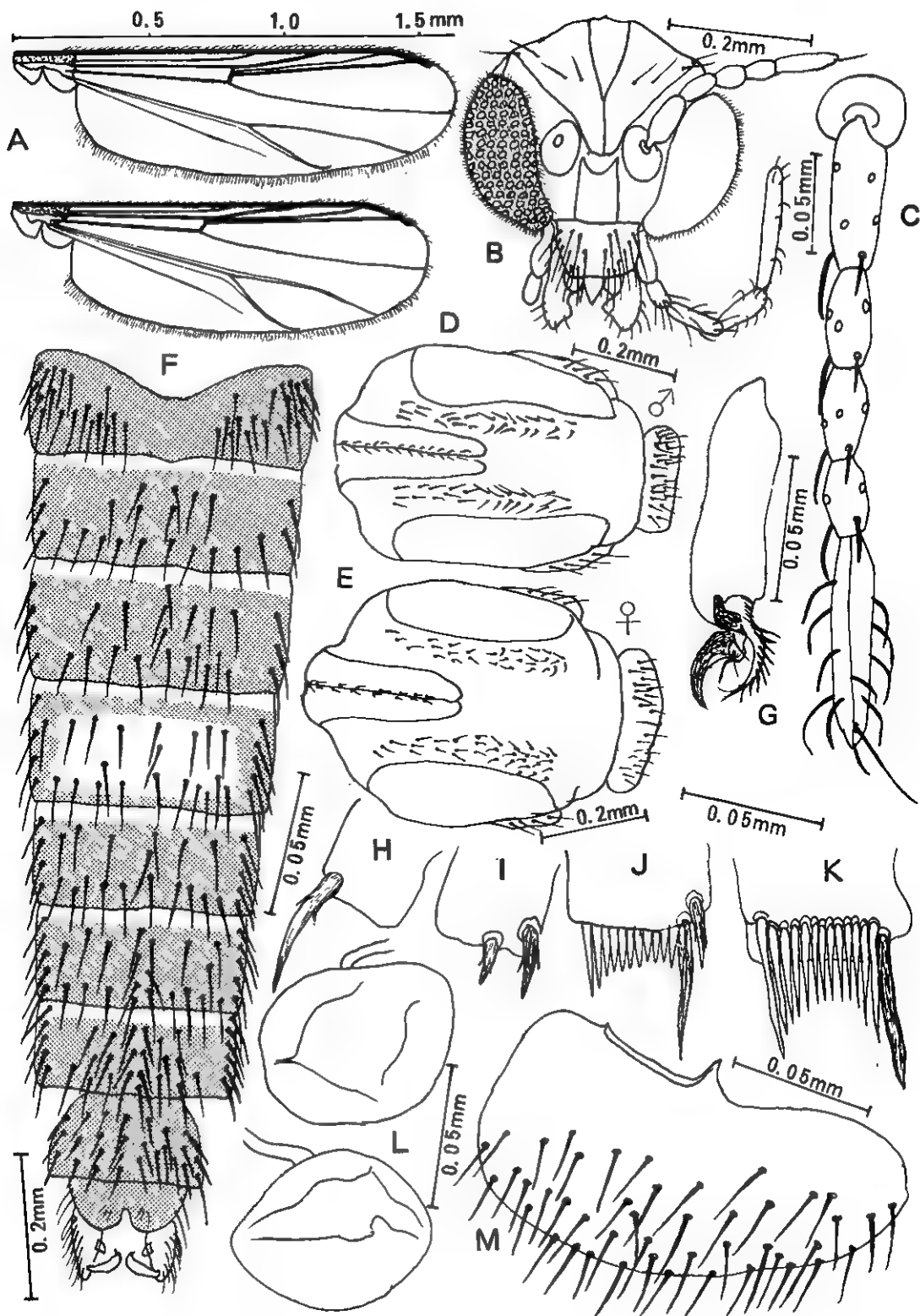


Plate 15. *Cricotopus tamapullus*, sp. nov., male and female

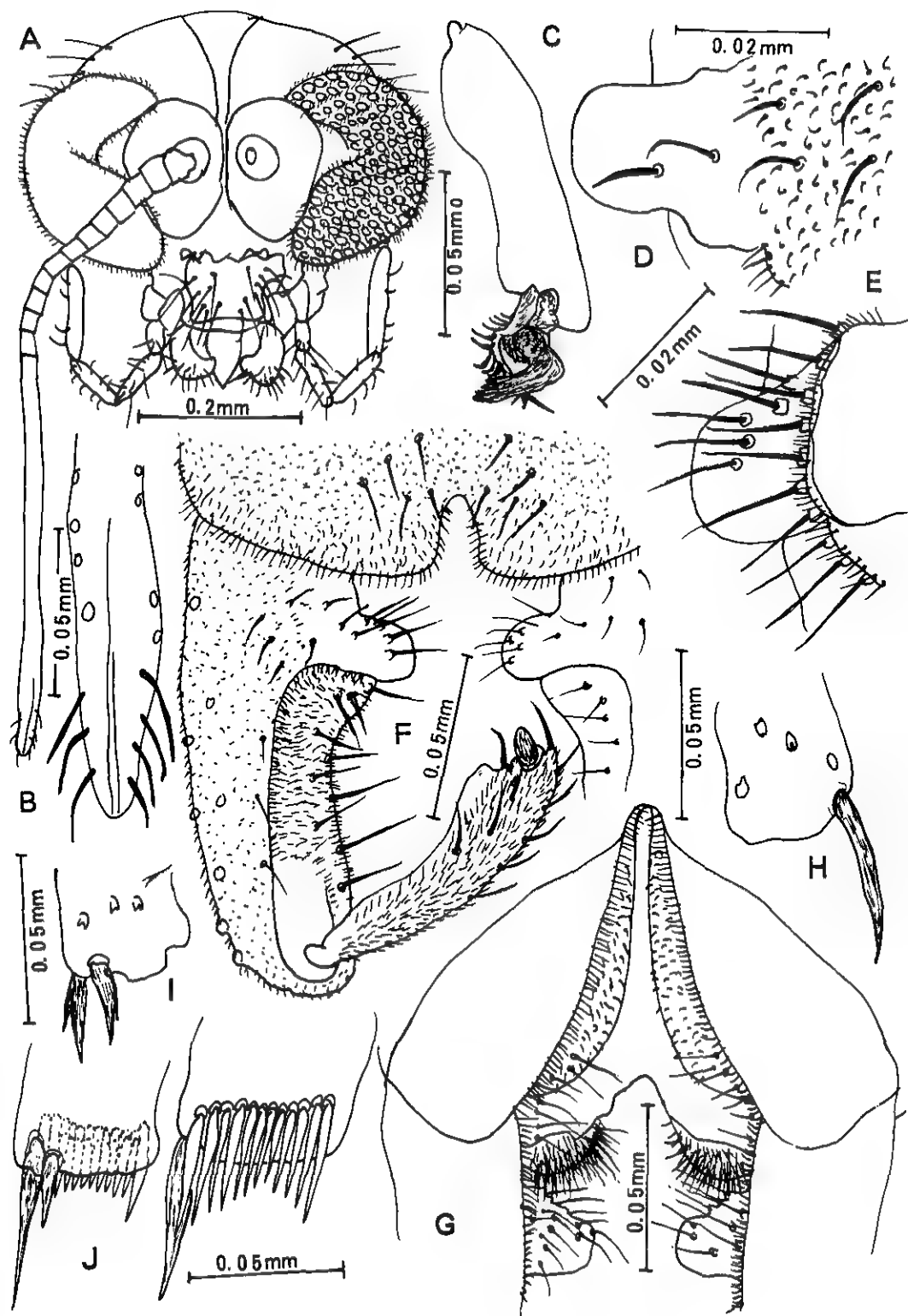


Plate 16. *Cricotopus tamapullus*, sp. nov., male

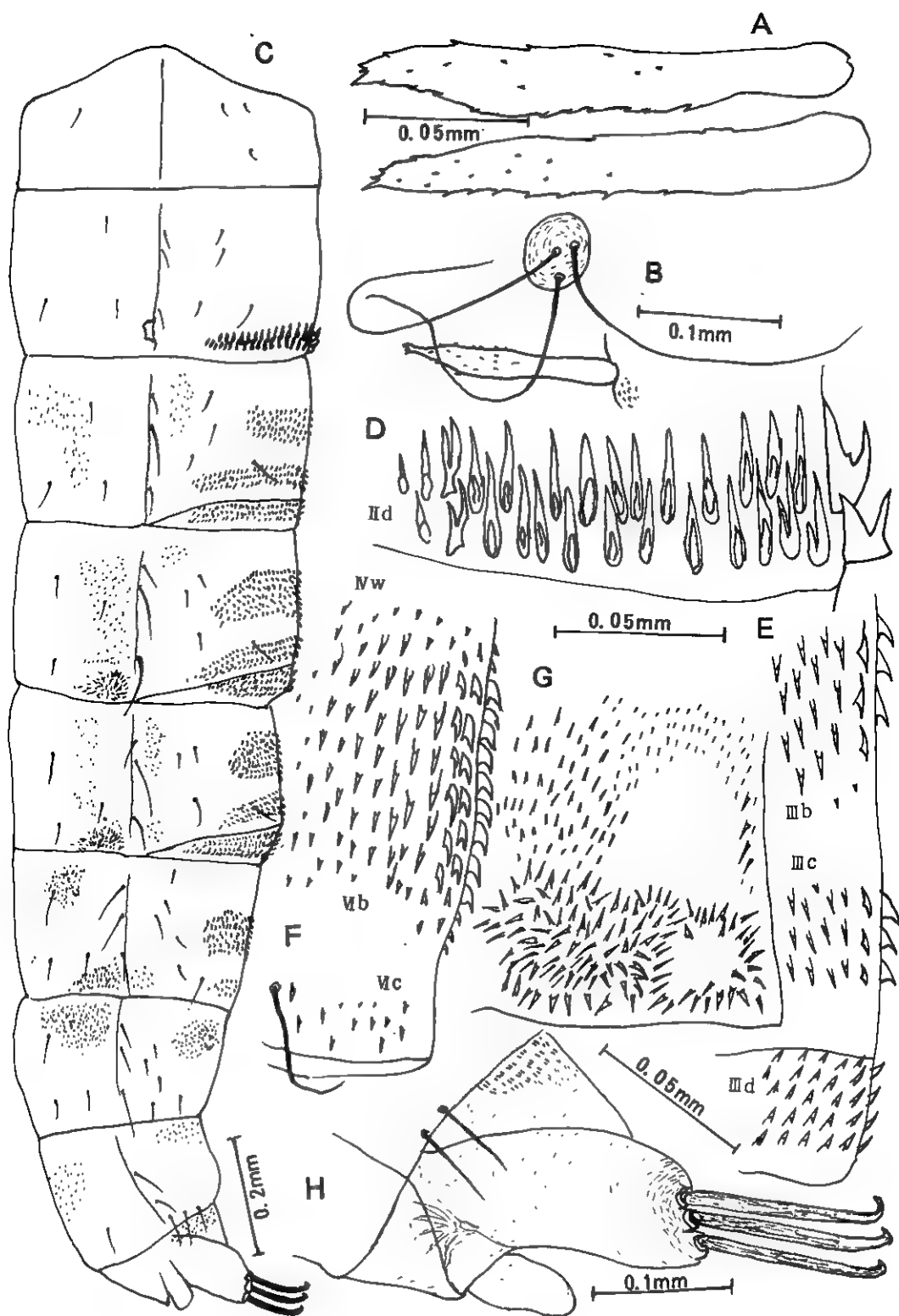


Plate 17. *Cricotopus tamapullus*, sp. nov., pupa

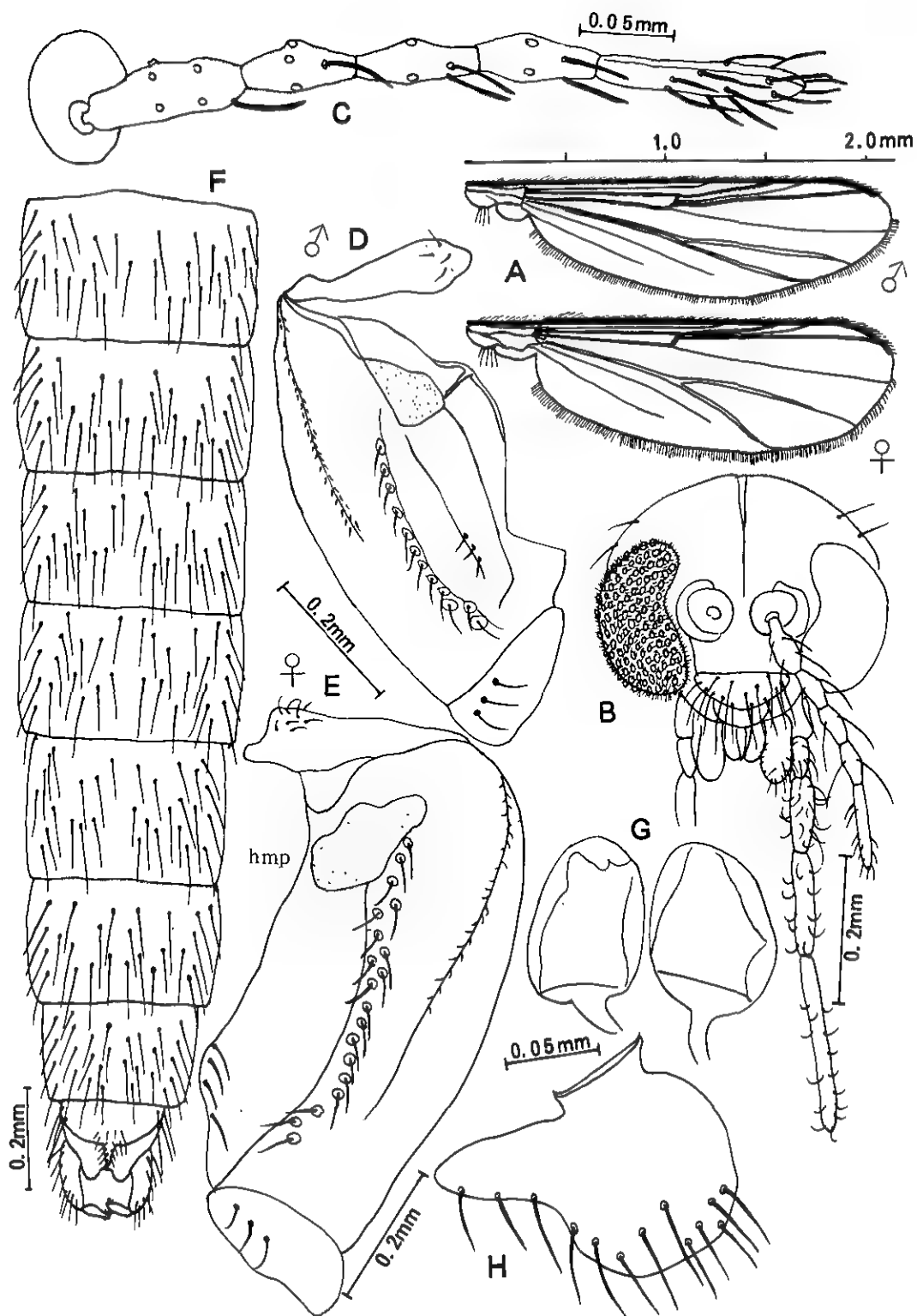


Plate 18. *Rheocricotopus tamahumeralis*, sp. nov., male and female

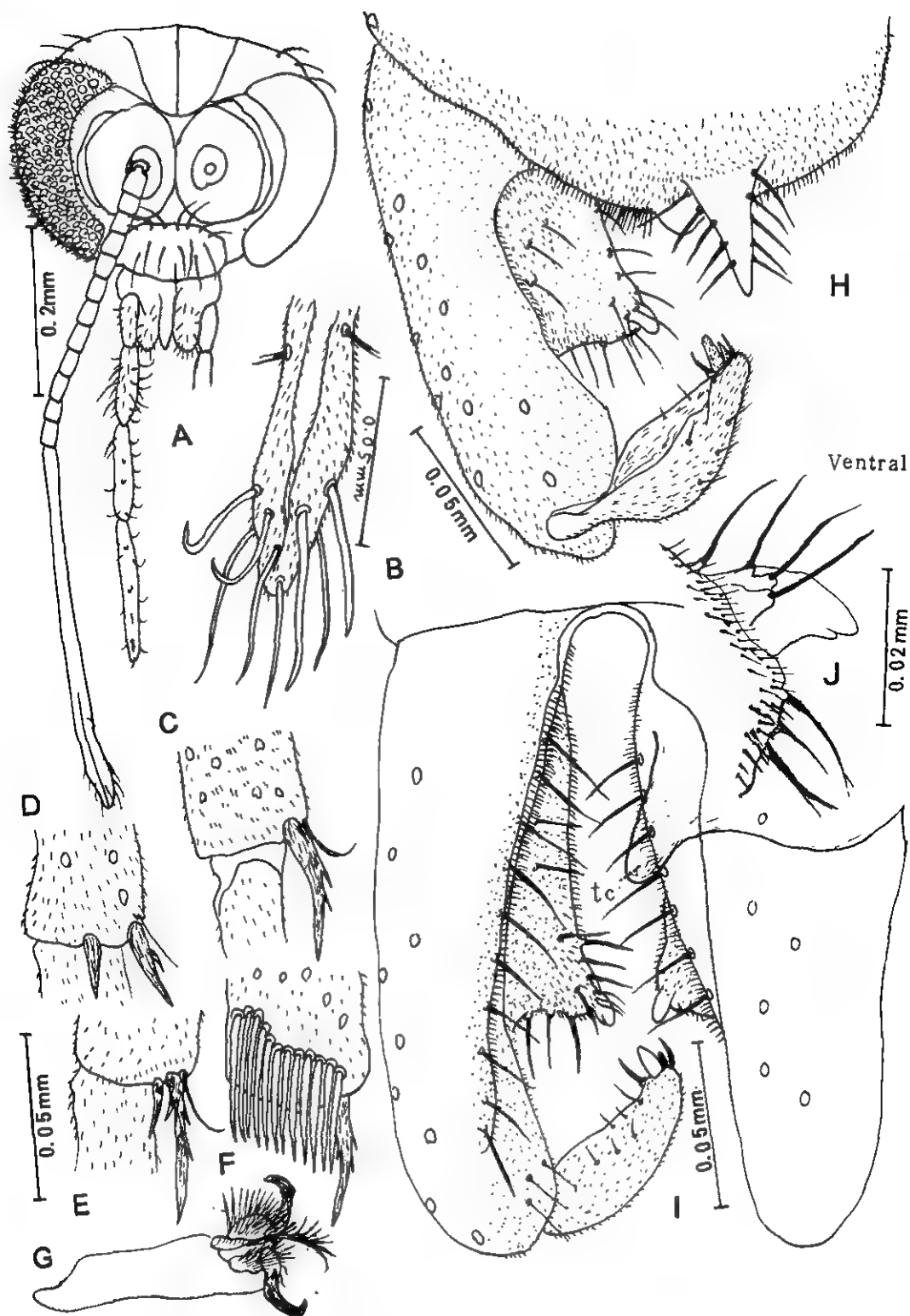


Plate 19. *Rheocricotopus tamahumeralis*, sp. nov., male

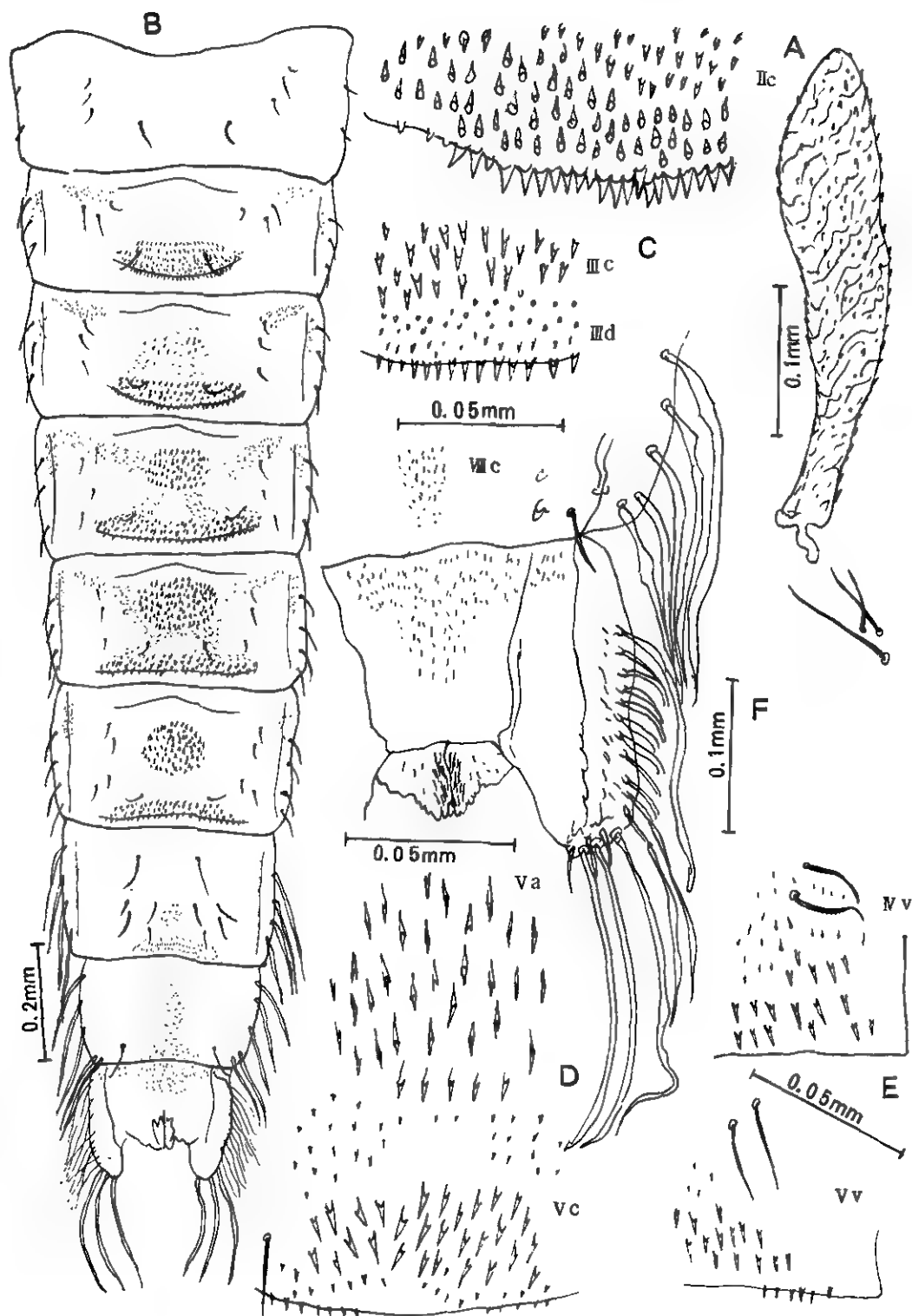


Plate 20. *Rheocricotopus tamahumeralis*, sp. nov., pupa

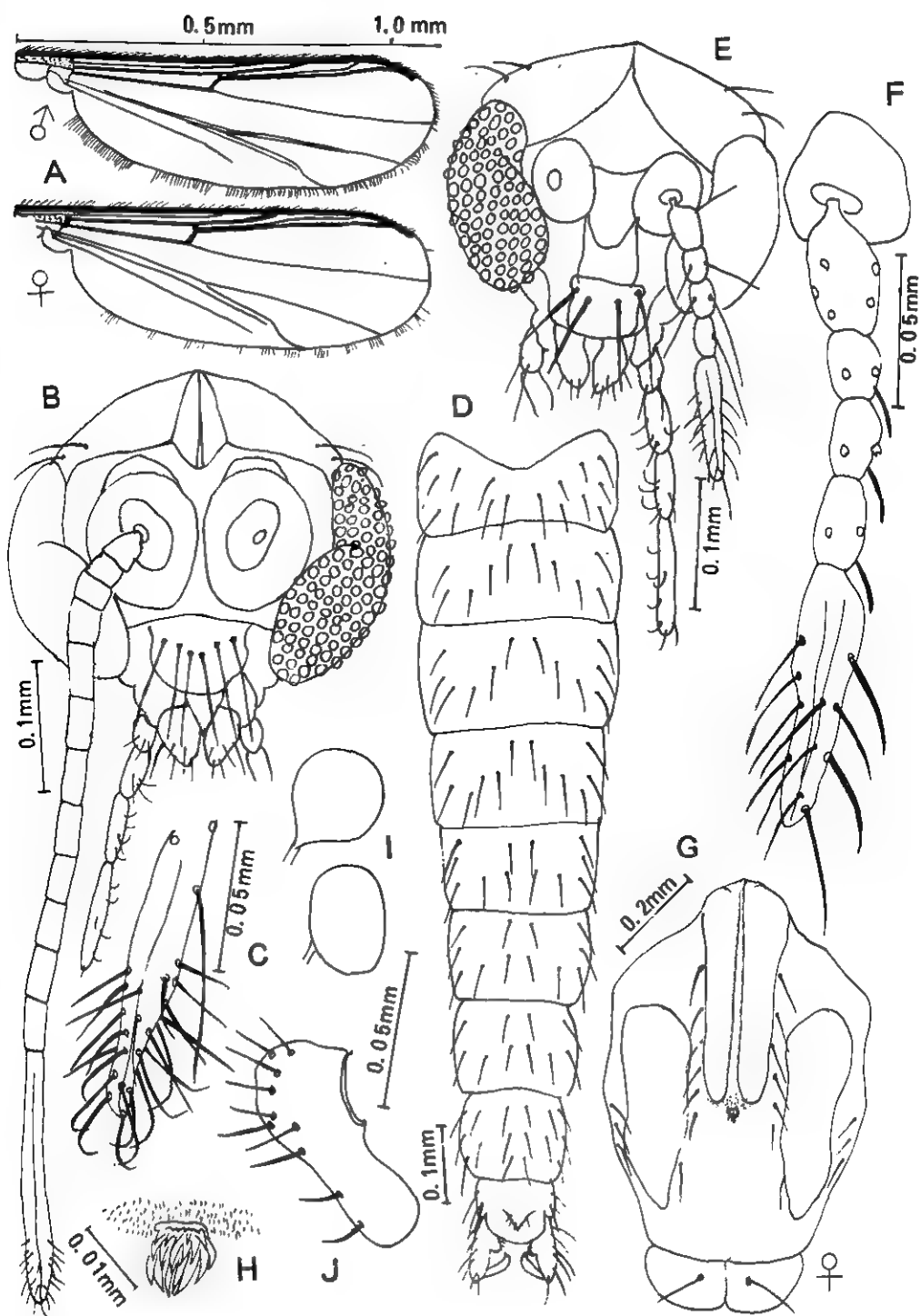


Plate 21. *Parakiefferiella tamatriangulatus*, sp. nov., male and female

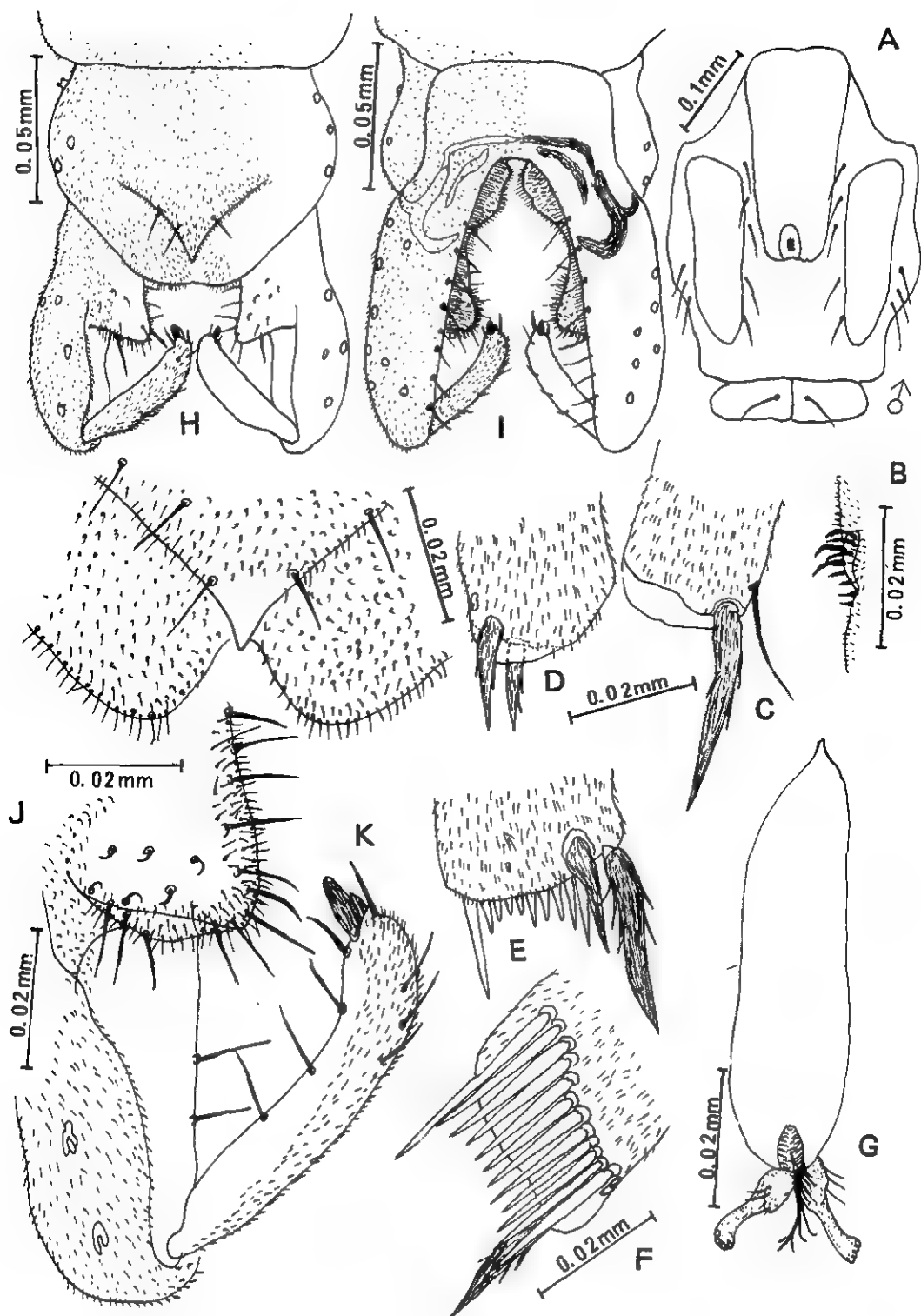


Plate 22. *Parakiefferiella tamatriangulatus*, sp. nov., male

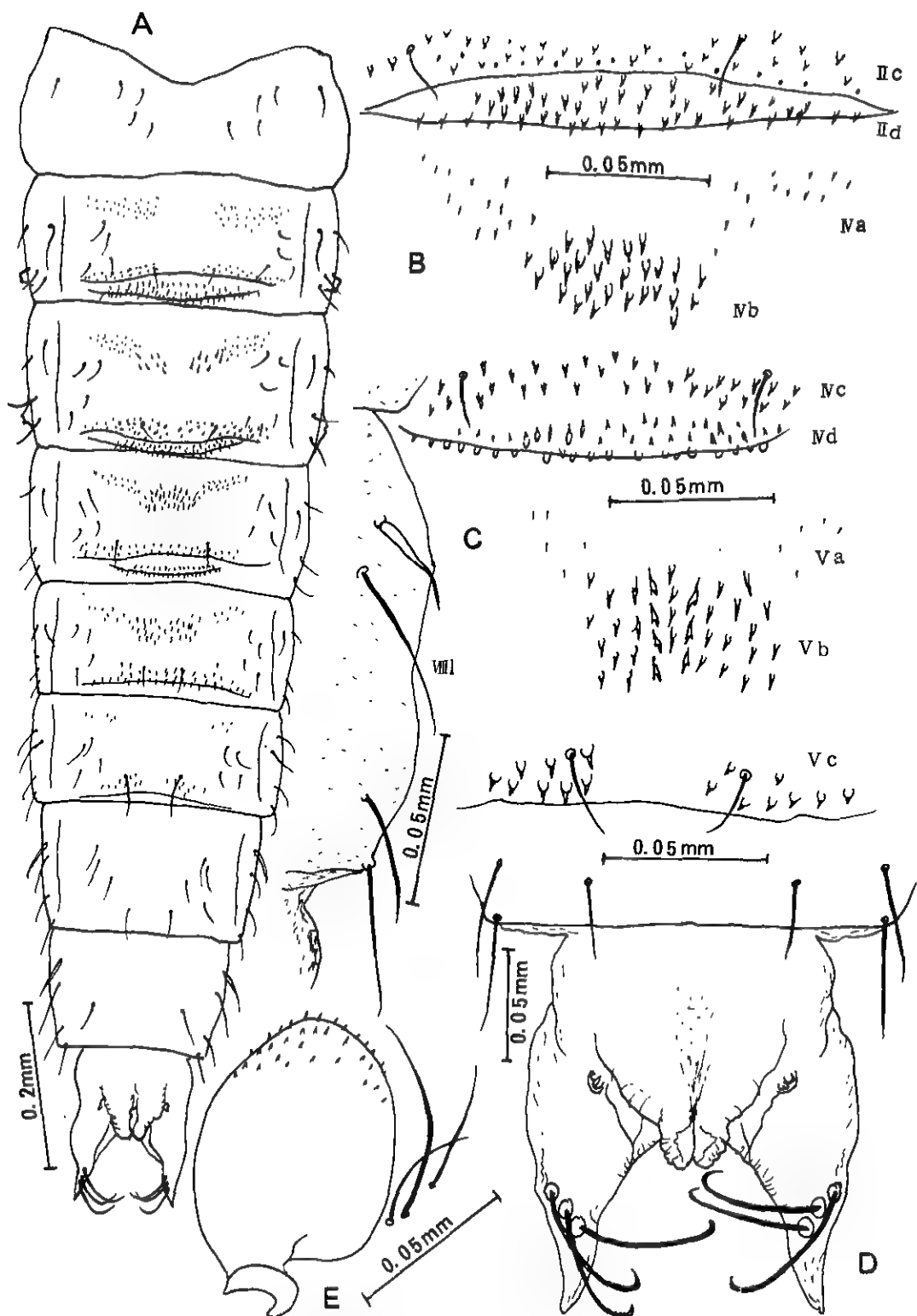


Plate 23. *Parakiefferiella tamatriangulatus*, sp. nov., pupa

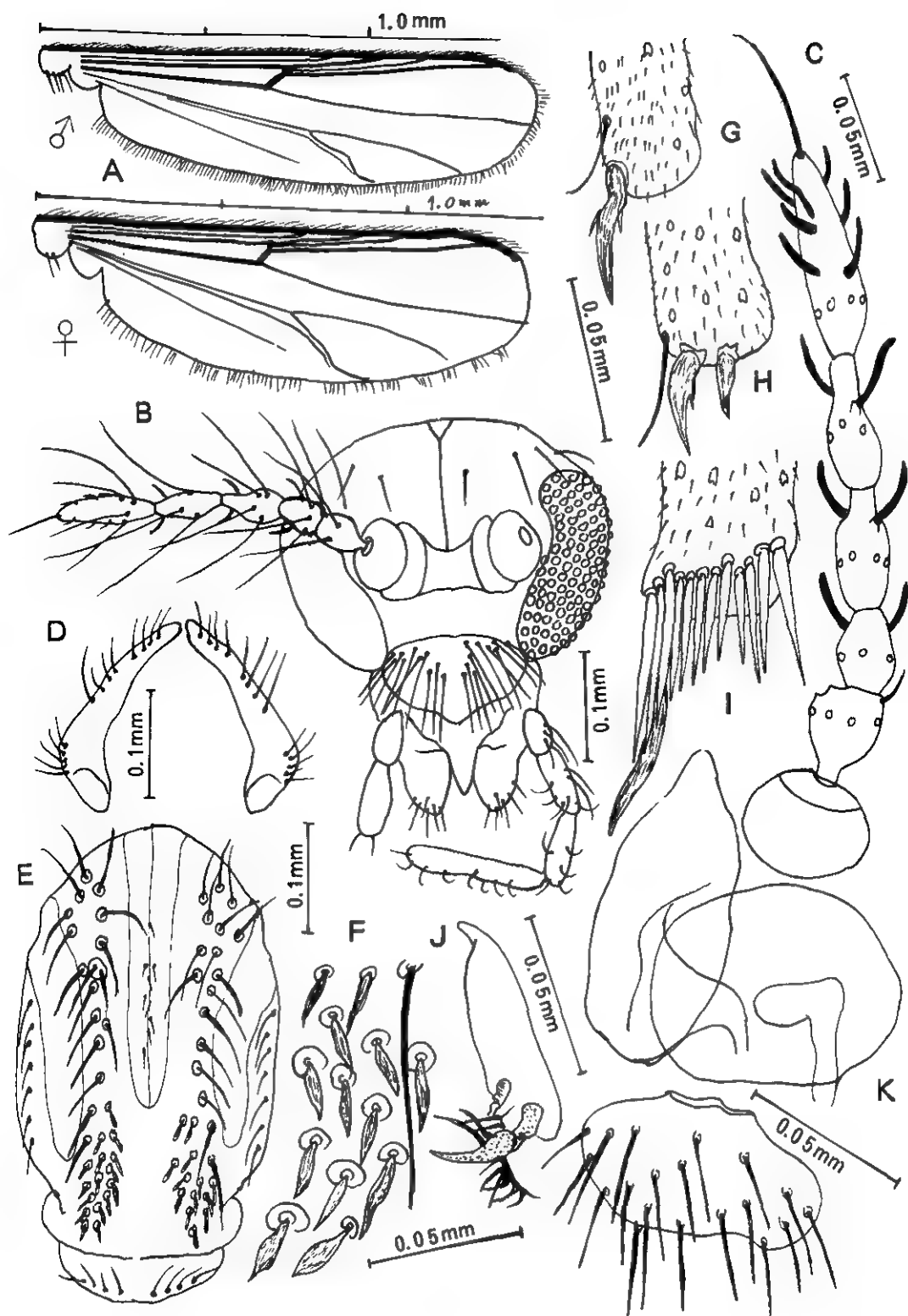


Plate 24. *Limnophyes tamakitanaides*, sp. nov., female

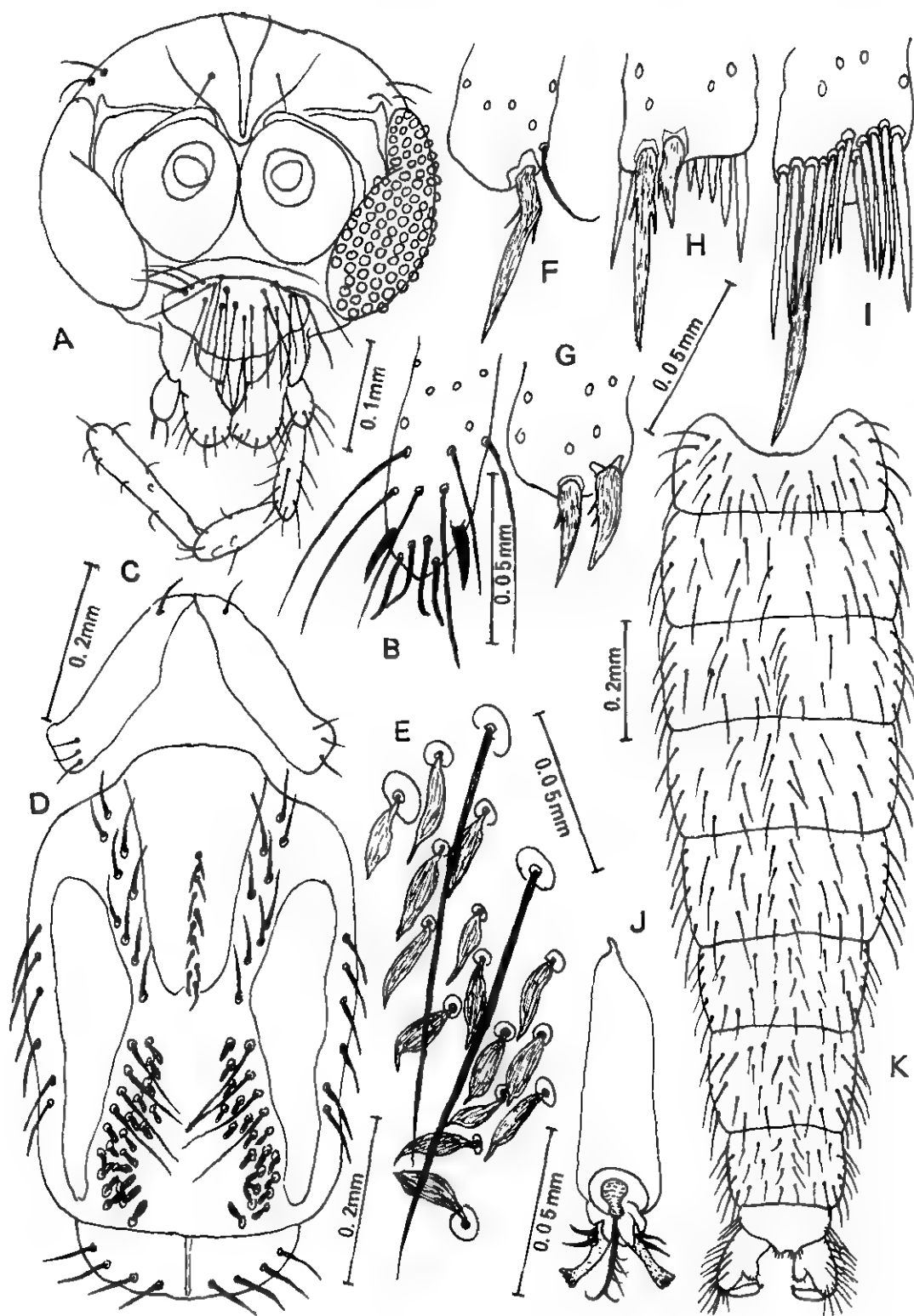


Plate 25. *Limnophyes tamakitanaides*, sp. nov., male

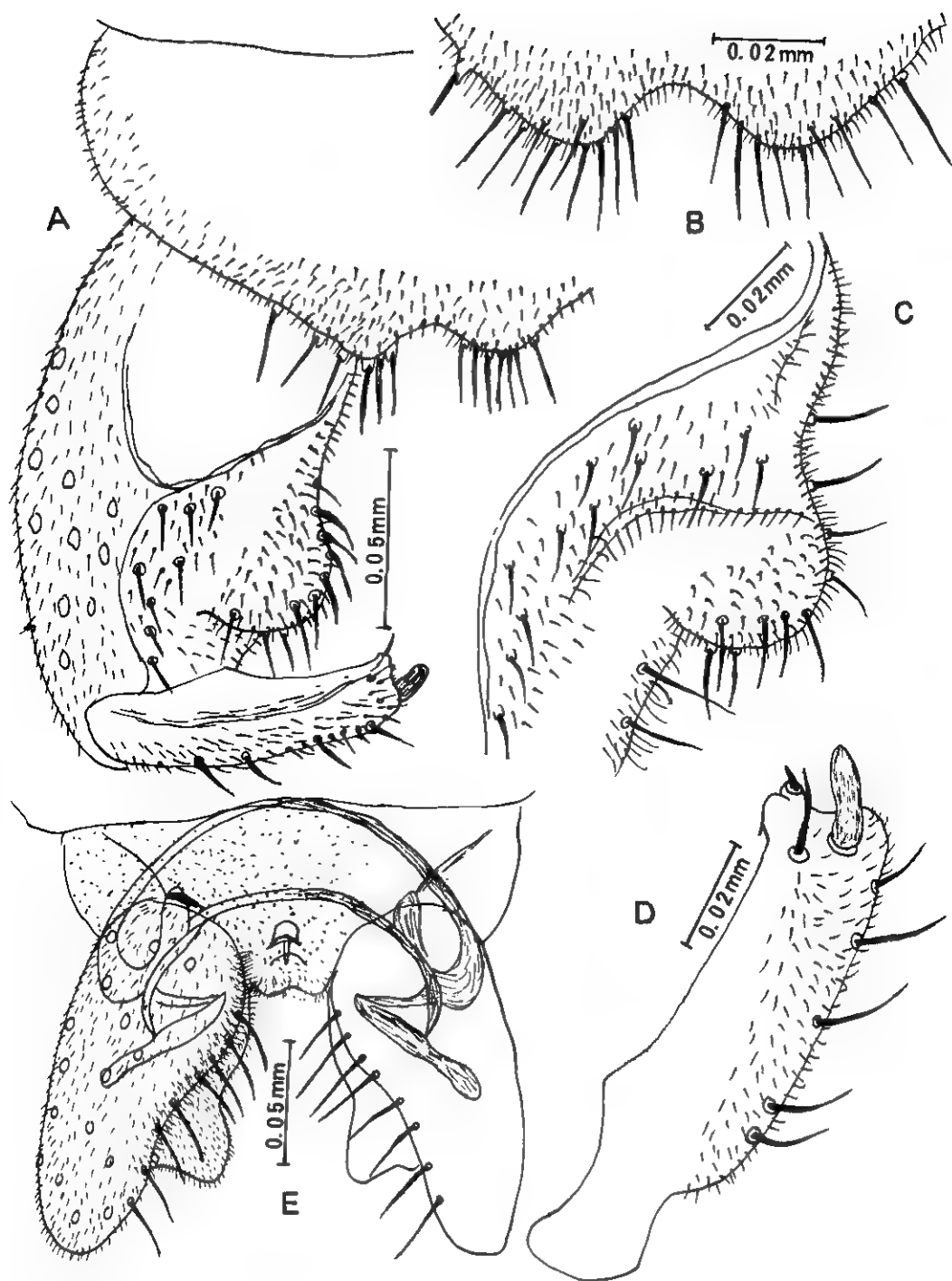


Plate 26. *Limnophyes tamakitanaides*, sp. nov., male hypopygium

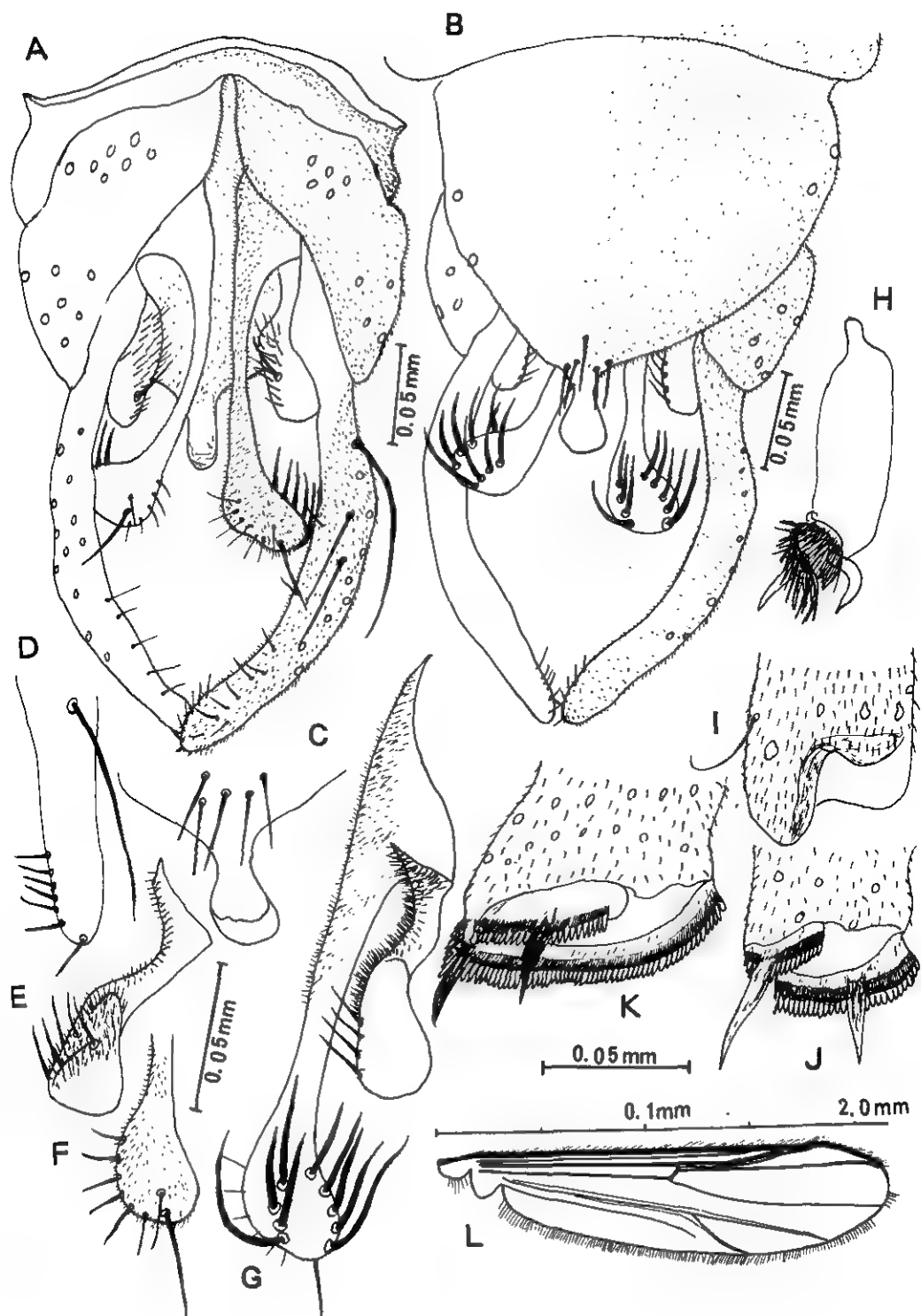


Plate 27. *Dicrotendipes tamaviridis*, sp. nov., male

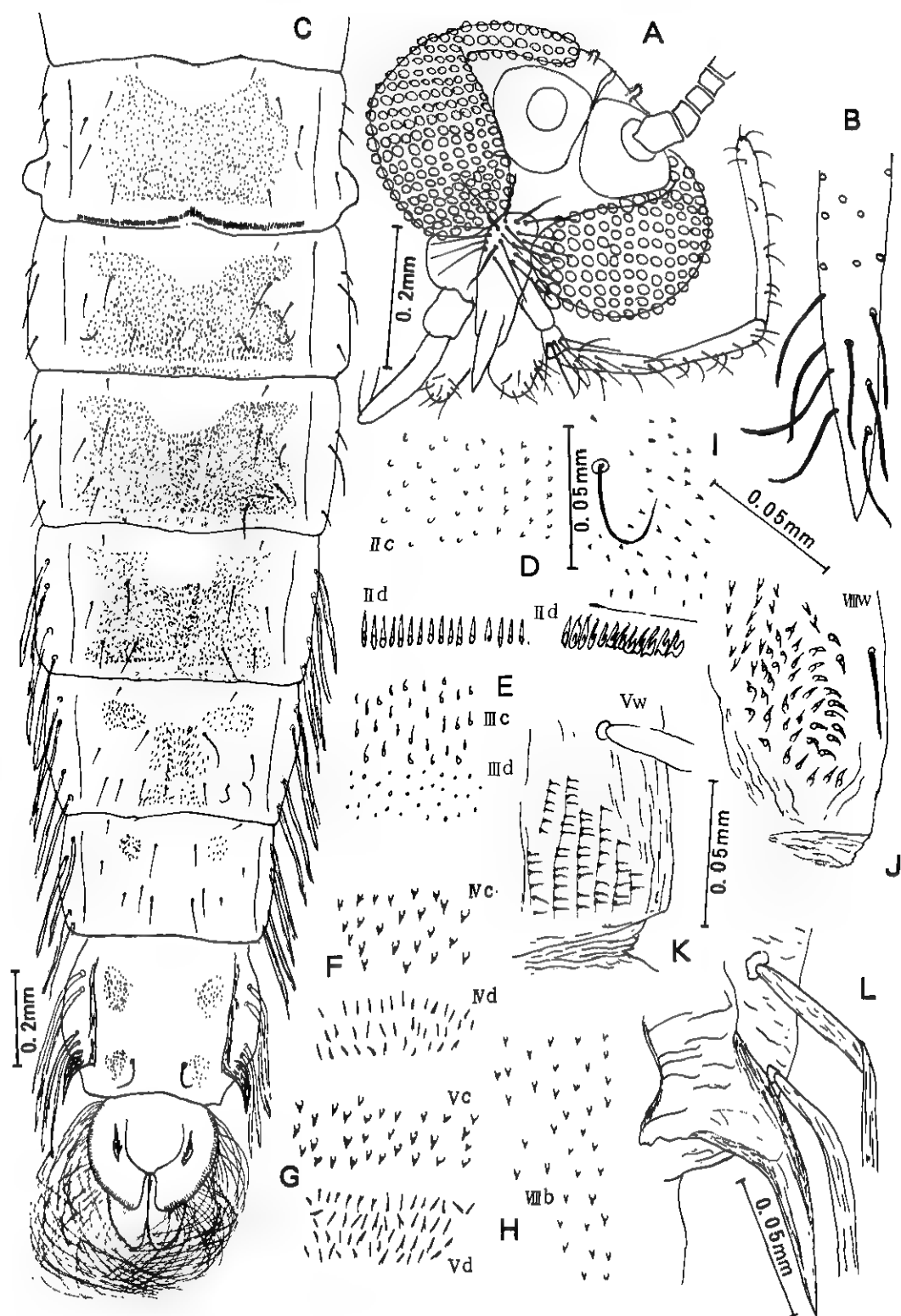


Plate 28. *Dicrotendipes tamaviridis*, sp. nov., male and pupa

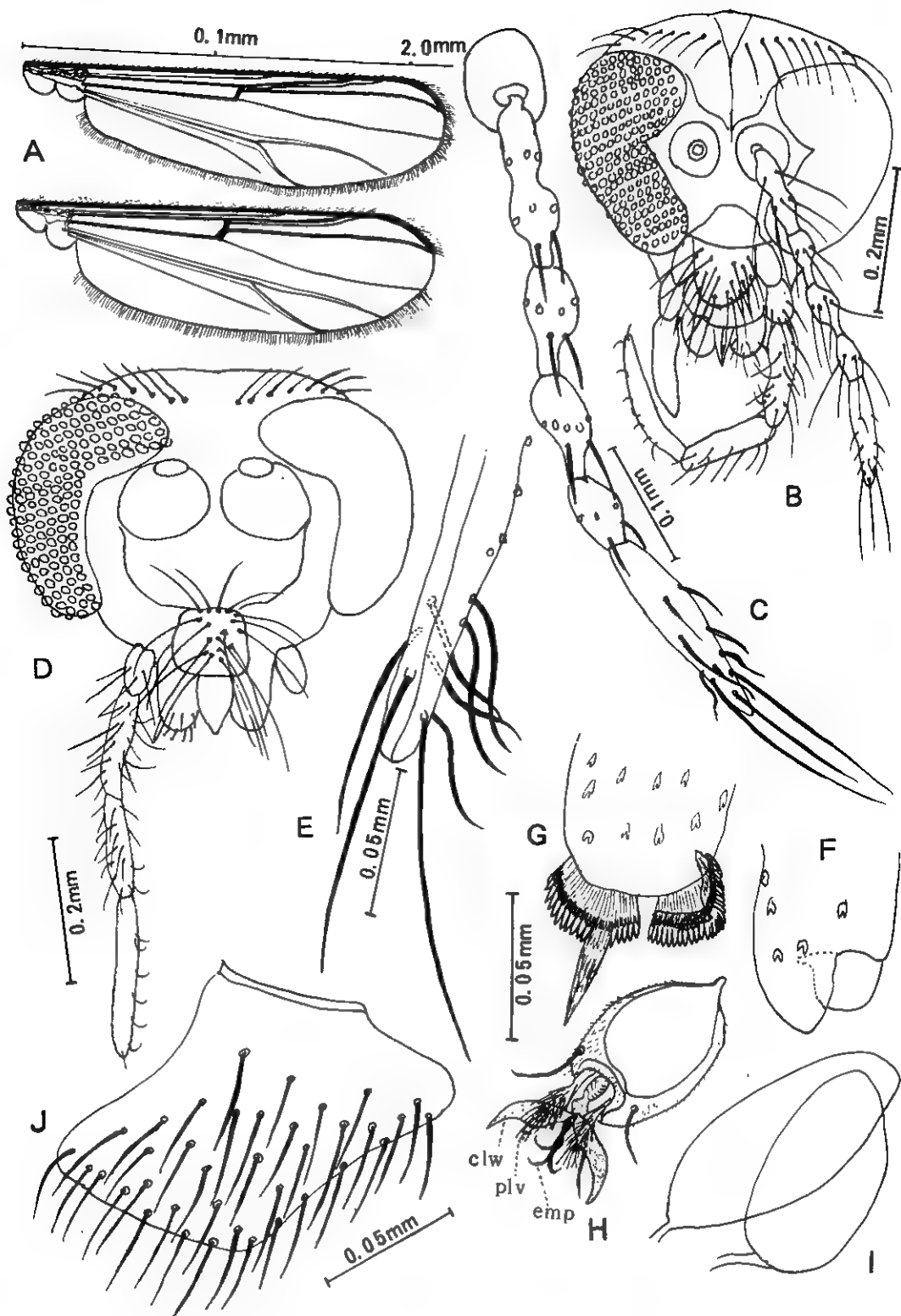


Plate 29. *Polypedilum kobotokense*, sp. nov., male and female

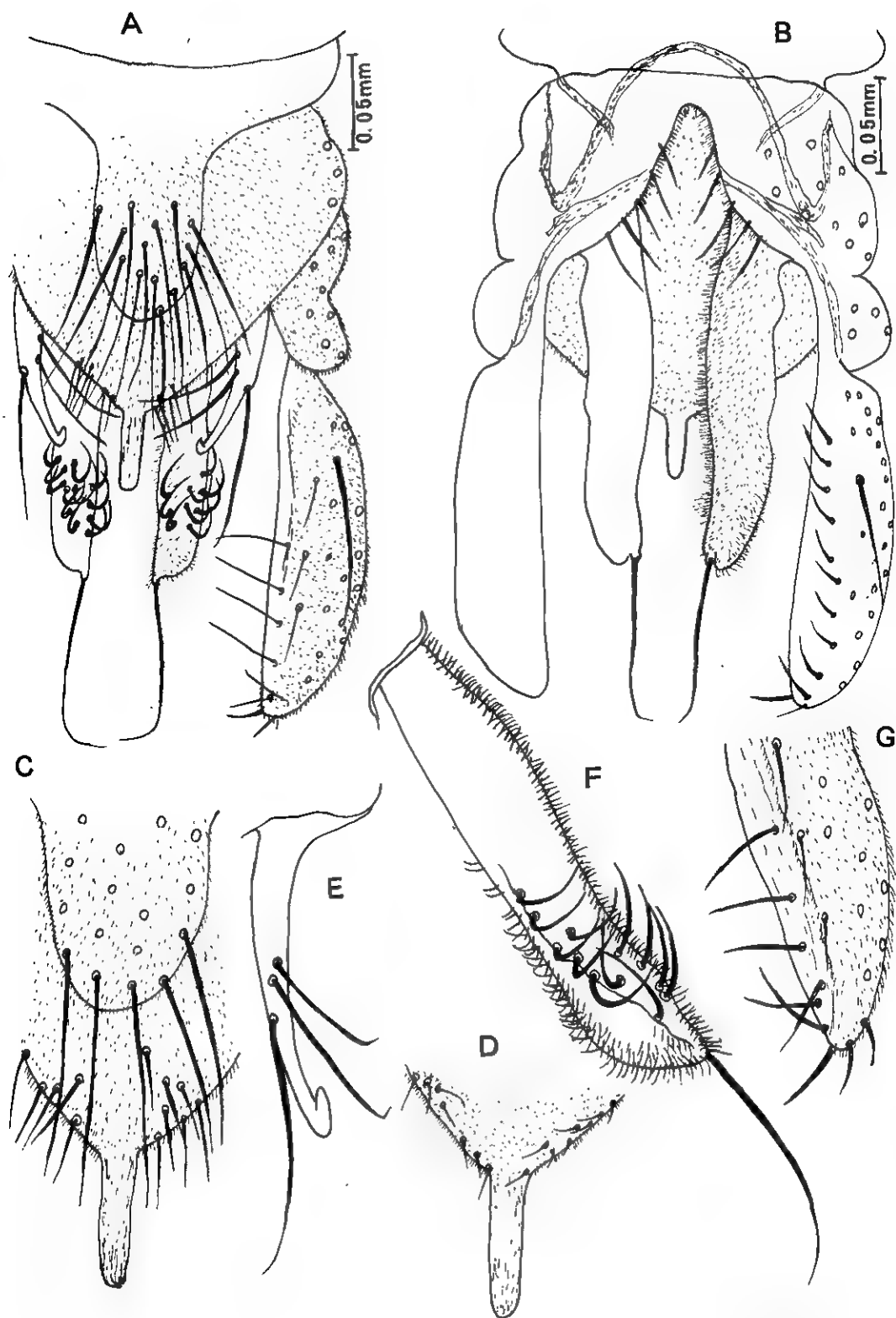


Plate 30. *Polypedilum kobotokense*, sp. nov., male hypopygium

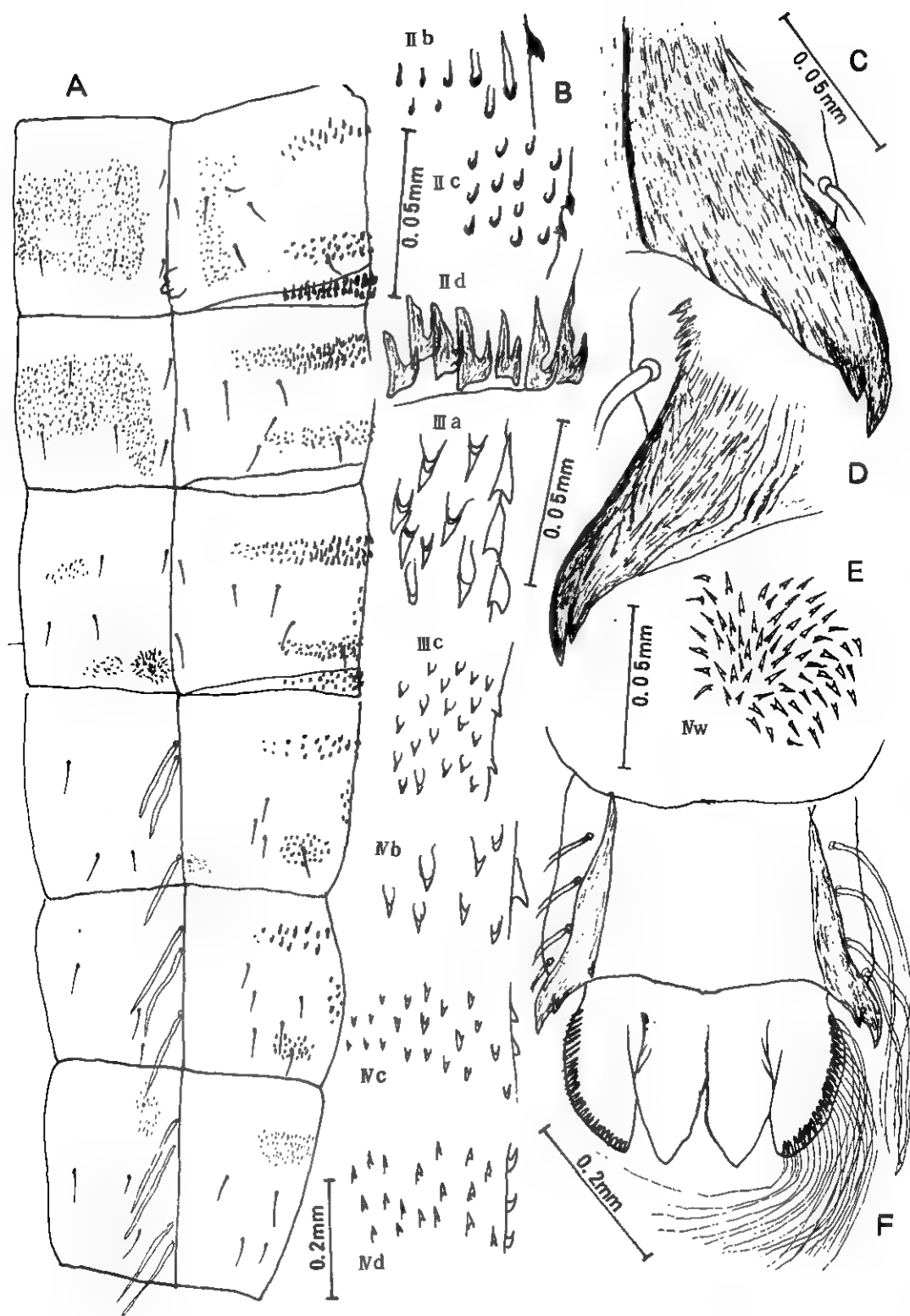


Plate 31. *Polypedilum kobotokense*, sp. nov., pupa

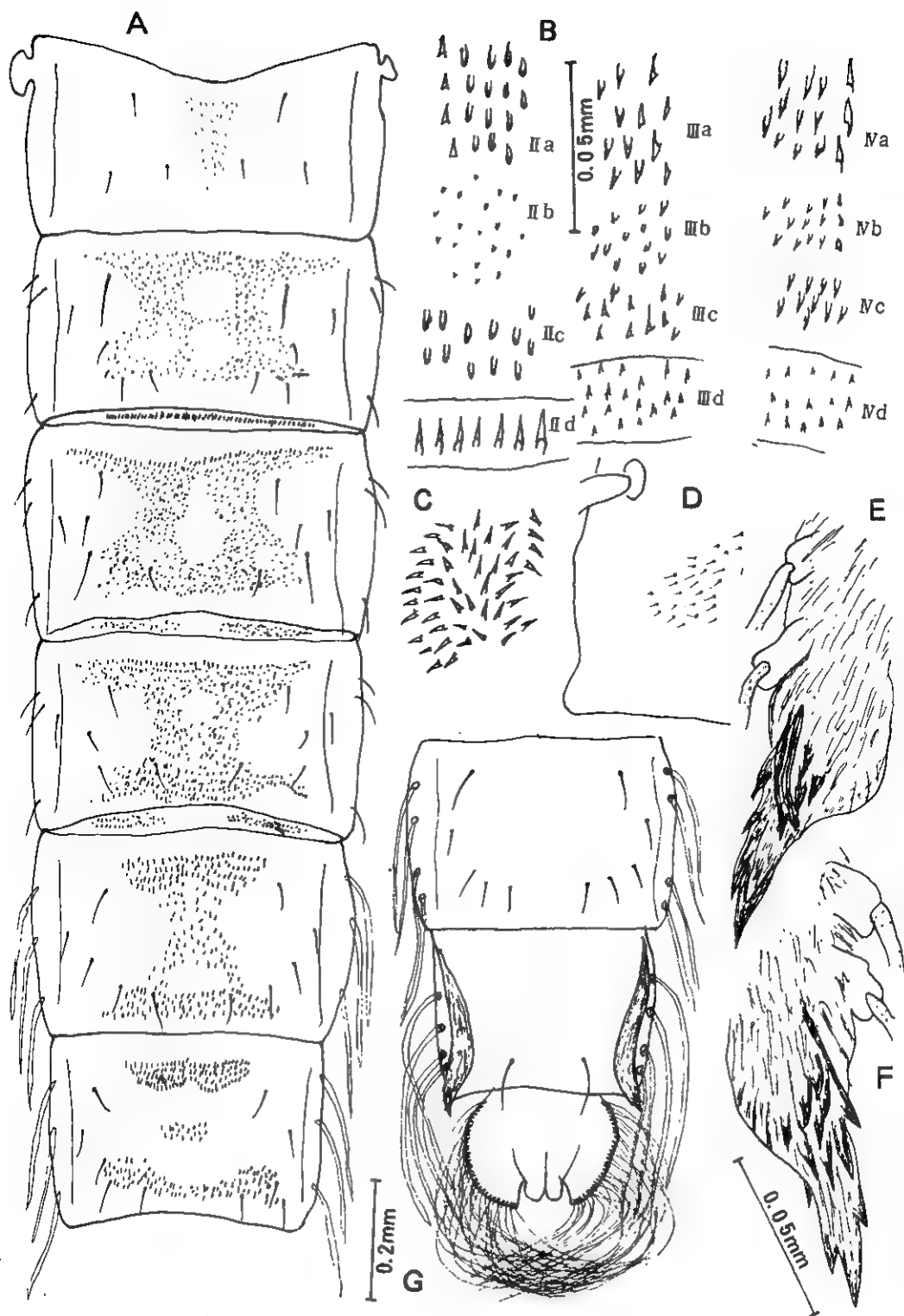


Plate 32. *Polypedilum asakawaense* (Sasa, 1980), pupa

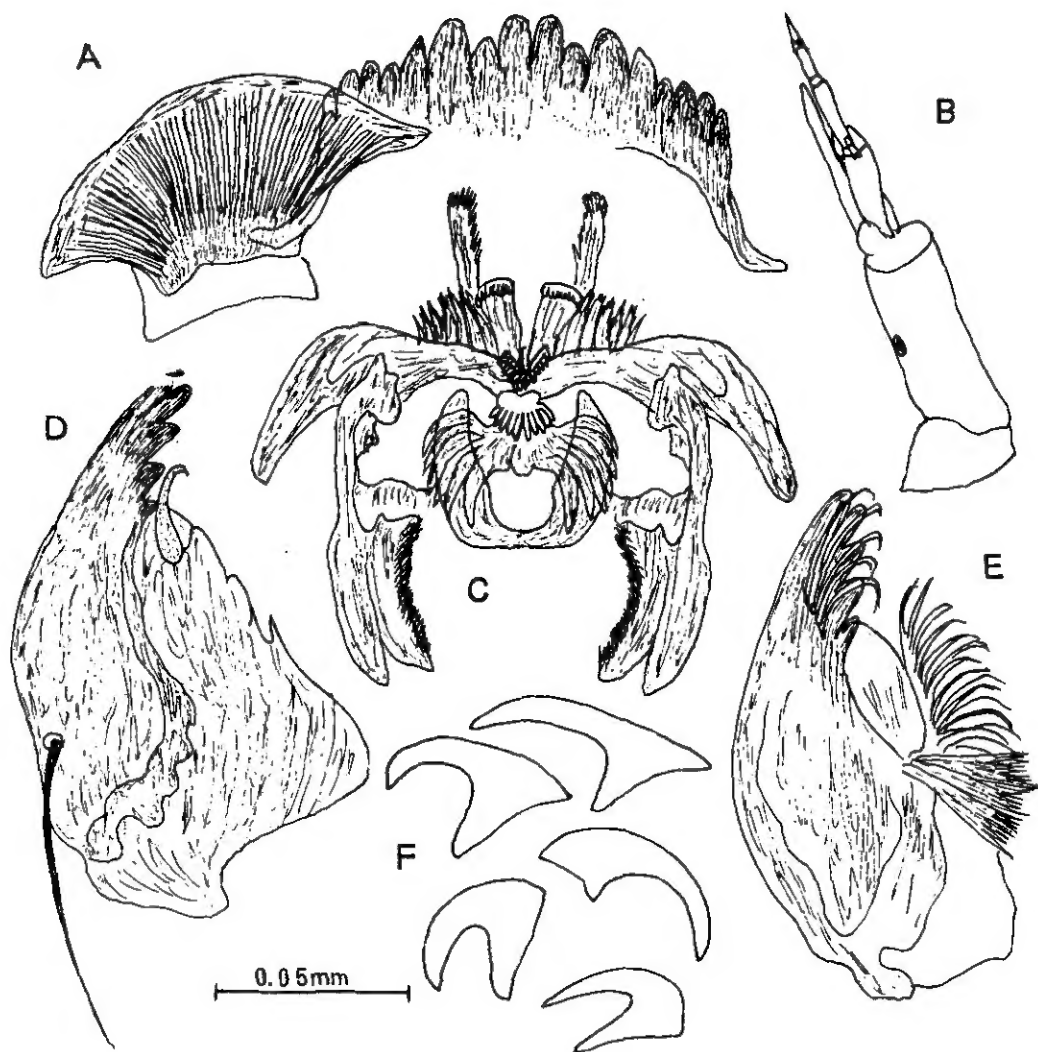


Plate 33. *Polypedilum asakawaense* (Sasa, 1980), larva

多摩川に発生するユスリカ類の研究

第4報 南浅川の冬期の調査で見出された各種の分布と記載

佐々学¹

さきに第1～3報で南浅川の6地点で夏期に採取した資料から発生したユスリカ類の分布と、その各期の形態について報告したが、今回は1979年12月12日に同じ地点で採取した資料から、同じ方法で回収された24種のユスリカの分布と、そのうち形態が未記載であった雄10種、雌9種、サナギ10種、幼虫2種について図説する。表1に示すように今回は最上流の1号地点ではわずか2匹の成虫がとれたのみであったが、その他の5地点については Orthocladinae と Chironominae だけでも24種が確認され、その分布は (1), (5), (8), (9), (10), (12), (13), (20), (22) のように最も汚染の少ない部分にだけ生息する種類、(3), (6), (7), (11), (16), (18) のように汚染の最もひどい地点に多発する種類、(2), (4), (15), (17), (19), (21), (23) のように中間の部位に分布する種類、というような住みわけがこゝにも見出された。

今回とれた23種のうち、夏と共通するのは (6), (7), (11), (12), (15), (17), (18), (21), (22), (23) の10種のみで、他の13種は夏には見出されない種類であった。そのうち10種は新種と判定せざるをえなかった。また、日本以外においてすでに記載されたユスリカと同一種と同定されたのは (6), (7), (17), (24) の4種にすぎなかった。

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Report of Special Research Project, the National Institute for Environmental Studies

- No. 1* Man activity and aquatic environment – with special references to Lake Kasumigaura – Progress report in 1966. (1977)
- No. 2* Studies on evaluation and amelioration of air pollution by plants – Progress report in 1976–1977. (1978)

[Starting with Report No. 3, the new title of NIES Reports was changed to:]

Research Report from the National Institute for Environmental Studies

- No. 3 A comparative study of adults and immature stages of nine Japanese species of the genus *Chironomus* (Diptera, Chironomidae). (1978)
- No. 4* Smog chamber studies on photochemical reactions of hydrocarbon-nitrogen oxides system – Progress report in 1977. (1978)
- No. 5* Studies on the photooxidation products of the alkylbenzene-nitrogen oxides system, and on their effects on Cultured Cells – Research report in 1976–1977. (1978)
- No. 6* Man activity and aquatic environment – with special references to Lake Kasumigaura – Progress report in 1977–1978. (1979)
- No. 7 A morphological study of adults and immature stages of 20 Japanese species of the family Chironomidae (Diptera). (1979)
- No. 8* Studies on the biological effects of single and combined exposure of air pollutants – Research report in 1977–1978. (1979)
- No. 9* Smog chamber studies on photochemical reactions of hydrocarbon-nitrogen oxides system – Progress report in 1978. (1979)
- No. 10* Studies on evaluation and amelioration of air pollution by plants – Progress report in 1976–1978. (1979)
- No. 11 Studies on the effects of air pollutants on plants and mechanisms of phytotoxicity. (1980)
- No. 12 Multielement analysis studies by flame and inductively coupled plasma spectroscopy utilizing computer-controlled instrumentation. (1980)
- No. 13 Studies on chironomid midges of the Tama River – Part 1. The distribution of chironomid species in a tributary in relation to the degree of pollution with sewage water. Part 2. Description of 20 species of Chironominae recovered from a tributary. (1980)
- No. 14* Studies on the effect of organic wastes on the spoil ecosystem – Progress report in 1978–1979. (1980)
- No. 15* Studies on the biological effects of single and combined exposure of air pollutants – Research report in 1979. (1980)
- No. 16* Remote measurement of air pollution by a mobile laser radar. (1980)
- No. 17* Influence of buoyancy on fluid motions and transport processes – Meteorological characteristics and atmospheric diffusion phenomena in the coastal region. (1980)
- No. 18 Preparation, analysis and certification of PEPPERBUSH standard reference material. (1980)
- No. 19* Comprehensive studies on the eutrophication of fresh-water areas – Lake current of Kasumigaura (Nishiura) – 1978–1979. (1981)
- No. 20* Comprehensive studies on the eutrophication of fresh-water areas – Geomorphological and hydrometeorological characteristics of Kasumigaura watershed as related to the lake environment – 1978–1979. (1981)
- No. 21* Comprehensive studies on the eutrophication of fresh-water areas – Variation of pollutant load by influent rivers to Lake Kasumigaura – 1978–1979. (1981)
- No. 22* Comprehensive studies on the eutrophication of fresh-water areas – Structure of ecosystem and standing crops in Lake Kasumigaura – 1978–1979. (1981)

- No.23* Comprehensive studies on the eutrophication of fresh-water areas -- Applicability of trophic state indices for lakes -- 1978-1979. (1981)
- No.24* Comprehensive studies on the eutrophication of fresh-water areas -- Quantitative analysis of eutrophication effects on main utilization of lake water resources -- 1978-1979. (1981)
- No.25* Comprehensive studies on the eutrophication of fresh-water areas -- Growth characteristics of *Microcystis* -- 1978-1979. (1981)
- No.26* Comprehensive studies on the eutrophication of fresh-water areas -- Determination of algal growth potential by algal assay procedure -- 1978-1979. (1981)
- No.27* Comprehensive studies on the eutrophication of fresh-water areas -- Summary of Researches -- 1978-1979. (1981)
- No.28* Studies on effects of air pollutant mixtures on plants -- Progress report in 1979-1980. (1981)
- No.29 Studies on chironomid midges of the Tama River -- Part 3. Species of the subfamily Orthocladiinae recorded at the summer survey and their distribution in relation to the pollution with sewage waters. Part 4. Chironomidae recorded at a winter survey. (1981)

* in Japanese